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NATIONAL DAM INSPECTION PROGRAM. FALLING SPRINGS DAM NDS ID NUM--ETC(U)
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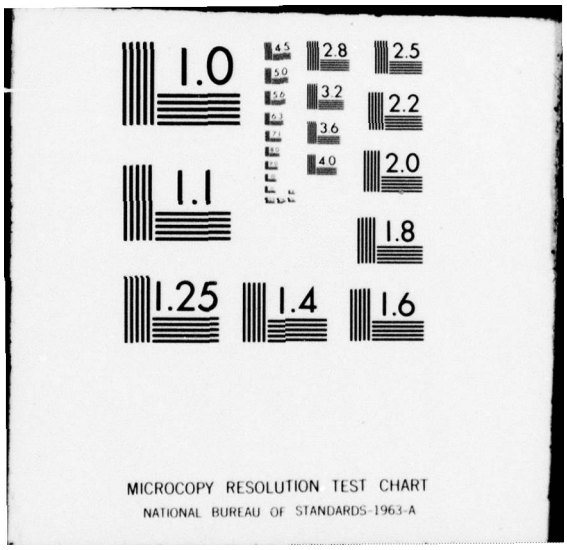
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SUSQUEHANNA RIVER BASIN
FALLING SPRINGS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

FALLING SPRINGS DAM
NDS ID [redacted] PA-00372,
DER ID [redacted] 35-39.
PENNSYLVANIA GAS AND WATER COMPANY.

Susquehanna River Basin, Falling Springs Creek, Lackawanna County, Pennsylvania.

PHASE I INSPECTION REPORT.
NATIONAL DAM INSPECTION PROGRAM.

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(15) DACW31-78-C-0046

Prepared by
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
Harrisburg, Pennsylvania 17105

For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

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LEVEL II

SUSQUEHANNA RIVER BASIN

FALLING SPRINGS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

FALLING SPRINGS DAM

NDS ID No. PA-00372
DER ID No. 35-39

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

Prepared by

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
P.O. Box 1963
Harrisburg, Pennsylvania 17105

For
Contract DACW31-78-C-0046

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

JULY 1978

SUSQUEHANNA RIVER BASIN

FALLING SPRINGS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

FALLING SPRINGS DAM

NDS ID No. PA-00372
DER ID No. 35-39

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1978

CONTENTS

PLATES

APPENDICES

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	Falling Springs Dam NDS ID No. PA-00372/ DER ID No. 35-39
Owner:	Pennsylvania Gas and Water Company
State Located:	Pennsylvania
County Located:	Lackawanna
Stream:	Falling Springs Creek
Date of Inspection:	5 June 1978
Inspection Team:	Gannett Fleming Corddry and Carpenter, Inc. P.O. Box 1963 Harrisburg, Pennsylvania 17105

Based on the visual inspection, available records, calculations, and past performance, Falling Springs Dam is judged to be in fair condition.

Under existing conditions, the spillway will not pass the Spillway Design Flood (SDF), which is one-half of the Probable Maximum Flood (PMF), without overtopping. Based on criteria established for these studies by the Department of the Army, Office of the Chief of Engineers (OCE), the spillway capacity is rated as inadequate. The existing spillway can accommodate a flood with a peak inflow of 74 percent of one-half of the PMF peak inflow and 112 percent of the 100-year flood peak inflow.

If the existing low areas were restored to design grade, the existing spillway could accommodate a flood with a peak inflow of 118 percent of one-half of the PMF peak inflow and the spillway would be rated as adequate.

In view of the concern for the safety of Falling Springs Dam, the following measures are recommended to be taken by the Owner as soon as practical:

(1) Develop a detailed emergency operation and warning system for Falling Springs Dam.

(2) Provide closure facilities for the outlet works on the upstream side of the main embankment for periodic inspection of the pipes and for emergency conditions.

In order to correct operational, maintenance and repair deficiencies, and to more accurately determine the condition of the dam, the following measures are recommended to be undertaken by the Owner in a timely manner:

(1) Perform additional studies to more accurately ascertain the spillway capacity required for Falling Springs Dam as well as the nature and extent of mitigation measures required to make the spillway hydraulically adequate. Also include provisions to repair the concrete of the spillway weir and right spillway abutment. If the existing low areas of the embankments are restored to design grade, the spillway capacity, according to the method used to analyze the spillway for this study, would be adequate. The filling in of low areas of the embankments could be considered a maintenance task.

(2) Remove brush and trees that are on or near the embankments. When the brush and trees are removed, the embankments should be inspected on a regular basis to check for wet areas or seepage.

(3) Install six or more observation wells, or other instrumentation, downstream of the axis of the main embankment. One well, or other instrumentation, should be located in the vicinity of each of the two wet areas. The others should be at appropriate locations to determine general water levels in the downstream main embankment.

(4) Install six or more observation wells, or other instrumentation, downstream of the axis of the auxiliary embankment. Two wells, or other instrumentation, should be located in the general swampy area downstream of the toe. One well, or other instrumentation, should be located near the wet area at the left abutment. The others should be at appropriate locations to determine general water levels in the downstream auxiliary embankment.

(5) Data collected from observation wells or other instrumentation should be utilized in evaluating the stability of the structures and assessing piping potential in the future. Continue to observe wet areas and measure and record seepage downstream of embankments. If conditions worsen, appropriate action should be taken to control seepage with properly designed drains.

(6) Investigate surface runoff from left abutment. If it is determined that the wet area at the left abutment of the auxiliary embankment is caused by surface runoff from the left abutment, provide positive drainage for the runoff.

(7) Repair or replace the downstream valve of the right outlet conduit. Maintain and operate the valves on both outlet conduits on a regular basis.

(8) Repair the concrete of the left outlet channel wall.

(9) Investigate scour damage that could occur during periods of high discharge at downstream end of spillway apron.

(10) Improve damsite access road to ensure access to dam under adverse weather conditions. Provide vehicular access to outlet works.

In addition, the following operational measures are recommended to be undertaken by the Owner:

Falling Springs

(1) Provide round-the-clock surveillance of Falling Springs Dam during periods of unusually heavy rains.

(2) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.

A. C. HOOKE
Head, Dam Section

Date: 31 July 1978

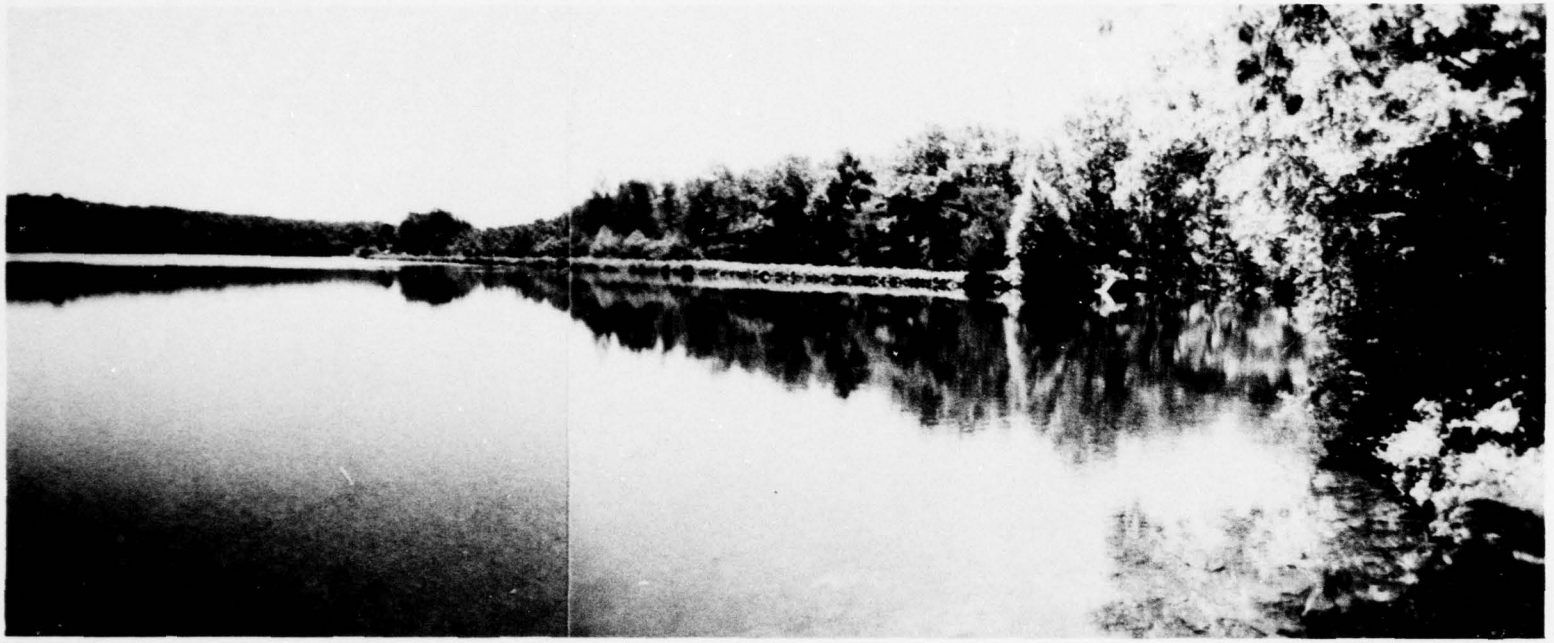
Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

Date: 31 July 1978

FALLING SPRINGS DAM



Spillway and Main Embankment
View from Right Abutment

35-35

SUSQUEHANNA RIVER BASIN

FALLING SPRINGS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

FALLING SPRINGS DAM

NDS ID No. PA-00372
DER ID No. 35-39

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

SECTION 1

PROJECT INFORMATION

ABSTRACT

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

ABSTRACT

1.2 Description of Project.

a. Dam and Appurtenances. Falling Springs Dam consists of two independent impoundment structures separated by high natural ground. Both impoundment structures

are earthfill embankments with concrete core walls. The main embankment is 825 feet long and contains the outlet works. In the base of the core wall of the main embankment, there is a drainage gallery with a 20-inch diameter cast-iron outlet pipe that discharges into the outlet works channel. The auxiliary embankment is 570 feet long. The maximum height of the main embankment is 61 feet at streambed. The top width of the embankments is 10 feet and both the upstream and downstream slopes are 1V on 2H.

The outlet works is located near the left abutment of the main embankment. Intake facilities are submerged and the details are unknown. The valve house with gate valves to control the flow in the two 20-inch cast-iron outlet conduits is located at the downstream toe. Both outlet pipes discharge into the outlet works channel, which directs the flow back into the natural streambed of Falling Springs Creek.

The spillway is located at the right end of the main embankment. The concrete, free overfall spillway weir is 80 feet long and 3 feet high. The spillway crest elevation is 3.5 feet below the top of dam elevation. The spillway discharge passes over the weir and falls onto the spillway apron, which consists of hand-placed riprap. At the downstream end of the spillway apron, the discharge drops 6 feet through boulders and large rock into an earthen channel. The earthen channel empties into Falling Springs Creek about 0.25 mile downstream.

b. Location. The dam is located on Falling Springs Creek about 1.3 miles upstream from the confluence of Falling Springs Creek and the Susquehanna River. Falling Springs Dam is shown mainly on USGS Quadrangle, Ransom, Pennsylvania, and partly on USGS Quadrangle, Pittston, Pennsylvania, with coordinates N41° 22'30" - W75° 47'10" in Lackawanna County and is 7 miles southwest of Scranton, Pennsylvania. The location of Falling Springs Dam is shown on Plate 1.

c. Size Classification. Intermediate (61 feet high and 898 acre-feet capacity).

d. Hazard Classification. Significant hazard. Downstream conditions indicate that a significant hazard classification for Falling Springs Dam is warranted (Paragraph 5.1e.).

e. Ownership. Pennsylvania Gas and Water Company, Wilkes-Barre, Pennsylvania.

f. Purpose of Dam. Water supply for Pittston, Old Forge, and surrounding communities.

g. Design and Construction History. Falling Springs Dam was built in 1905 by the Spring Brook Water Supply Company. The design and construction supervision was performed by John H. Lance, Chief Engineer of the Spring Brook Water Supply Company. In 1922, a drainage ditch was built at the left end of the main embankment to remedy a swampy condition that had been experienced at the toe of the embankment near the left abutment. In 1929, the spillway was rebuilt. The length of the spillway was increased from 40 feet to 80 feet, and the spillway crest elevation was set at the former top of flashboards elevation at 1352.74. The top of the embankments were raised so that a freeboard of 3.5 feet was available on the new spillway crest.

h. Normal Operational Procedure. Excess reservoir inflow is discharged over the spillway. A portion of the flow in Falling Springs Creek is diverted 0.6 mile downstream of the dam into an earthen canal that feed into Campbell Ledge Storage Reservoir. Water is discharged from Campbell Ledge Storage Reservoir into Campbell Ledge Intake, where the water is distributed to Pittston, Old Forge, and Taylor. When the pool level at Campbell Ledge Storage Reservoir falls below the spillway crest elevation, additional water is released from Falling Springs Reservoir through the left outlet conduit to augment the flow into Campbell Ledge Storage Reservoir.

1.3 Pertinent Data.

a. Drainage Area. 1.25 square miles.

b. Discharge at Damsite. (cfs.)

Maximum known flood at damsite - 520 (estimated - August 1955).

Outlet works at maximum pool elevation - 27.

Spillway capacity at maximum pool elevation - 1,110.

c. Elevation. (Feet above msl.)(1)

Design top of dam - 1356.2

Actual top of dam - varies 1356.2 to 1355.2.

Maximum pool - 1355.2.

Normal pool - 1352.74.

Upstream invert outlet works - 1287.0 (estimated).

Downstream invert outlet works - 1286.14.

Streambed at centerline of dam - 1285.0.

d. Reservoir Length. (Miles.)

Normal pool - 0.66.

Maximum pool - 0.71.

e. Storage. (Acre-feet.)

Normal pool (spillway crest) - 774.
Maximum pool (top of dam) - 898.

(1) Datum used for elevations is based on approximate USGS datum. The datum used on the Owner's drawings is based on a different datum. The equivalence is Elevation 1352.74 (USGS) equals Elevation 517.0 (Drawings).

f. Reservoir Surface. (Acres.)

Normal pool (spillway crest) - 49.
Maximum pool (top of dam) - 50.2.

g. Dam.

Type - Homogeneous earthfill structure with central concrete core wall.

Length - Main (right) embankment - 825 feet.
Auxiliary (left) embankment - 570 feet.

Height - Main (right) embankment - 61 feet.
Auxiliary (left) embankment - 18 feet.

Top width - 10 feet.

Slopes - Upstream 1V on 2H.
Downstream 1V on 2H.

Zoning - Homogeneous earthfill.
Central concrete core wall.

Cutoff - Concrete core wall founded on rock.

Grout curtain - None.

h. Diversion and Regulating Tunnel. None.

i. Spillway.

Type - Broad-crested weir (width 10 inches) with adverse approach slope 1V on 2H (total width 5 feet) and free overfall.

Length of weir - 80 feet.

Crest elevation - 1352.7.

Upstream channel - 1V on 2H rock-faced embankment to Elevation 1350.7.

Downstream channel - Hand-placed stone apron sloping gently away from spillway for 60 feet, then free overfall of 6 feet into rock-lined channel.

j. Regulating outlets.

Type - Two low level 20-inch diameter cast-iron pipes.

Length - 290 feet.

Access - None.

Regulating facilities. - Two manually operated nonrising stem, enclosed 20-inch gate valves, with exposed 3 to 1 spur and pinion gear reducers.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. Very little engineering data was available for review for the original structures. In a study performed in 1914 by the Pennsylvania Water Supply Commission, an account of design concepts, geology, construction materials and methods, and design features was prepared for the structures from interviews with the Owner, visual inspection, and other sources. The 1914 study also included analyses for hydrology and hydraulics. A summary of the results of the analyses is on file. Subsequent studies and inspections by the Commission were the bases for the recommended improvements to the spillway that were made in 1929.

b. Design Features. Falling Springs Dam consists of two independent impoundment structures, the main embankment and the auxiliary embankment. The embankments are connected by high natural ground. The outlet works is located at the main embankment. The locations of the various features are shown on Plate 2. A discussion on geology is presented in Appendix E.

The main embankment consists of a 825-foot long earth embankment with a concrete core wall (Photographs A and B). In the base of the core wall is a drainage gallery with a 20-inch diameter cast-iron outlet pipe that discharges into the outlet works channel at the downstream toe of the main embankment. The maximum height of the main embankment is about 61 feet. The auxiliary embankment consists of a 570-foot long earth embankment with a concrete core wall (Photographs I and J). Foundation investigations made for the 1914 Commission Report indicate fairly hard shale near the surface with many outcrops. The right end of the main embankment abuts the spillway, and the left end of the main embankment ties into high natural ground. Both ends of the auxiliary embankment abut high natural ground. The embankments are 10 feet wide at the top. The bottom widths vary

to a maximum of 250 feet. The upstream slopes are paved with hand-placed riprap (Photograph K), and the downstream slopes are sodded. The slopes are 1V on 2H. A rock-lined drainage gutter was constructed in 1922 at the toe of the main embankment near the left abutment to alleviate a wet area that had existed for several years. The gutter discharges into the natural streambed of Falling Springs Creek about 180 feet downstream.

The spillway is located at the right end of the main embankment. The height of the concrete free overfall spillway is about 3 feet; the length is 80 feet; and the crest is at Elevation 1352.7 (Photographs C and D). The spillway crest is flanked by concrete abutments. Spillway plan, profile, and sections are shown on Plates 3 and 4. The present spillway replaced the original spillway in 1929. The original spillway was also a concrete, free overfall structure. Disintegration of the spillway and spillway abutment concrete had been extensive enough to require that the Owner make the repairs. At that time, it was decided to raise the spillway crest to the top of the 2-foot high flashboards that had been in use for years and to widen the spillway crest from 40 feet to 80 feet. It was also decided to raise the embankments to bring them to an elevation that is 3.5 feet above the present spillway crest. The spillway apron is a 60-foot long section of hand-placed riprap that is located immediately below the spillway crest (Photograph E). At the downstream end of the spillway apron, the invert drops sharply into an earthen channel (Photograph F). Flow from the spillway joins flow from the outlet works about 0.25 mile downstream of the dam.

The outlet works, which contains the reservoir drawdown facilities, is located near the left abutment of the main embankment. Intake structure conditions are unknown, other than the presence of steel screens in the reservoir. The 1914 Commission report does not mention any closure facilities for the outlet works on the upstream side of the embankment. The valve house with gate valves to control the flow in the outlet pipes is located at the downstream toe. Two 20-inch diameter cast-iron pipes can draw water from the reservoir. Each line has

two manually operated gate valves on it. Both lines discharge into the outlet works channel (Photograph G), which in turn discharges into the natural channel of Falling Springs Creek. About 0.6 mile downstream from Falling Springs Dam, water is diverted from Falling Springs Creek into an earthen canal for 0.3 mile into Campbell Ledge Storage Dam. Campbell Ledge Storage Dam supplies water to Campbell Ledge Intake Dam, which distributes water to Pittston, Old Forge, and Taylor.

Access to Falling Springs Dam is by a 2-mile unpaved road that belongs to the Owner. The access road leads to the left abutment of the auxiliary embankment, from where it proceeds across the crest of the auxiliary embankment to the high natural ground and then across the crest of the main embankment to the spillway. There is no access road to the outlet works.

2.2 Construction.

a. Data Available. Construction data available for review for the original structures was limited to information contained in the 1914 report prepared by the Pennsylvania Water Supply Commission. That information was obtained by interviews with the Owner, and it gives details of the construction. Details of the construction for the 1929 spillway modification are available.

b. Construction Considerations. The 1914 report and subsequent inspections by the Commission raised two concerns about the construction of Falling Springs Dam. The first concern was that shortly after the dam was constructed, several slides occurred in the embankments that indicated that the embankment material was not properly compacted. It was believed that some material was placed in freezing weather, which resulted in the formation of large clods that were never properly compacted. The slides were repaired, and no further movement in the embankment was noticed in the next several years. The second concern was that the downstream toe of the main embankment at the left abutment was saturated with water that probably came from the left abutment rock. The Commission required that a rock-lined channel be constructed to drain the water so that the potential for a slide of the embankment would be reduced.

According to a 1917 report by the Commission, the material for the embankments was placed without rolling, which was not unusual for dams built by the Spring Brook Water Supply Company. Therefore, the likelihood of slides and settlement was high.

Review of the available information for the 1929 spillway modification did not yield pertinent information with respect to the character of that work.

2.3 Operation. No formal records of operation were reviewed. Based on information from the Owner and the caretaker of the dam, all structures have performed satisfactorily. The caretaker, who has been associated with Falling Springs Dam for 33 years, said that he could not recall when flow over the spillway exceeded 18 inches.

2.4 Other Investigations. No known investigations other than those previously described were reviewed.

2.5 Evaluation.

a. Availability. Engineering data was provided by the Division of Dams and Encroachments, Bureau of Water Quality Management, Department of Environmental Resources, Commonwealth of Pennsylvania, and by the Owner, Pennsylvania Gas and Water Company. The Owner made available an engineer and a caretaker for information and operating demonstrations during the visual inspection. The Owner also researched his files for additional information upon the request of the inspection team.

b. Adequacy. The type and amount of design data and other engineering data are limited, and the assessment must be based on the combination of available data, visual inspection, performace history, hydrologic assumptions, and hydraulic assumptions.

c. Validity. There is no reason to question the validity of the available data.

SECTION 3

VISUAL INSPECTION

3.1 Findings.

a. General. The general appearance of this project indicated that some project features have deteriorated with age and are in need of repair, while other project features have been properly maintained and are in good condition.

b. Dam.

(1) Main Embankment. The main embankment was generally in good condition from what could be seen. However, brush and young trees with an average height of about 12 feet were growing on the downstream slope of the embankment and hindered the inspection. The growth was quite dense in places, with the diameter of the trees varying to up to 3 inches. Results of the survey of the downstream slope indicate that the slope varies slightly, but not significantly, from the design slope of 1V on 2H. A fallen 50-foot tree was decaying on the slope. There was a row of mature evergreen trees that were spaced at about 12-foot intervals at the toe of the embankment. Several trees of about 12-foot height and 4-inch diameter were grouped near the junction of the main embankment with the left end of the spillway. The riprap on the upstream face of the main embankment is generally in place and is in good condition. There is a general cover of light brush about 18 inches in height on the upstream slope above the normal pool elevation.

There were two wet areas at the downstream toe of the main embankment near the left abutment. The first wet area was the result of seepage through a 40-foot by 100-foot portion of the vertical rock face immediately downstream of the left abutment. The seepage was collected by a rock-lined channel and joined the flow from the outlet channel about 180 feet downstream. The seepage was clear, and the flow in the rock-lined channel was about 5 to 10 gpm. The second wet area was observed about 20 feet to the right of the rock-lined channel and

was approximately 3 feet wide and 15 feet long. The flow from the second wet area drained into the rock-lined channel and was estimated to be less than 0.5 gpm. The discharge from the second wet area was also clear.

The survey of the top of the main embankment revealed that the elevation along the top of dam was irregular. The lowest point on the top of dam was about 0.9 foot below design top of dam elevation.

(2) Auxiliary Embankment. The auxiliary embankment was generally in good condition from what could be seen. However, 3.5-foot high brush, growing on the downstream slope of the embankment, hindered the inspection. Results of the survey of the downstream slope indicate that the slope was slightly flatter than the design slope of 1V on 2H. The area immediately downstream of the toe was covered with mature broadleafed trees with an average height of about 60 feet. The riprap on the upstream face of the main embankment is generally in place and is in good condition. There is a general cover of light brush about 18 inches in height on the upstream slope above the normal pool elevation.

Two wet areas were observed near the auxiliary embankment. The first wet area was a general swampy area of triangular shape below the downstream toe near the middle of the auxiliary embankment. The length of the wet area along the toe was about 200 feet, and the standing water extended about 600 feet downstream of the toe. There was no outlet for the wet area, and there was no discernable flow. Old cuttings of brush and small trees were lying in the swampy area near the toe. The second wet area was a small pool of standing water at the left abutment on the downstream side (Photograph L). The pool area was 6 feet long and 5 feet wide, and the pool was 0.5 foot deep. It appeared that the pool collected surface runoff that had drained along the access road to the dam. There was no discernable outflow from the pool.

The survey of the top of the auxiliary embankment revealed that the elevation along the top of dam was irregular. The lowest point along the top of dam was about 1.0 foot below design top of dam elevation.

c. Appurtenant Structures.

(1) Spillway. In general, the concrete of the spillway weir and spillway abutments was in satisfactory condition. Since water was flowing over the spillway crest, the downstream face of the spillway weir could not be closely inspected. It was observed, however, that moss was growing on the face and that coarse aggregate was exposed in several places across the face and crest. Concrete was spalled to an average distance into the reservoir of about 9 inches and to an average vertical depth of about 10 inches at three locations across the spillway crest. Two of the spalled areas were at the monolith joints. The joint filler was missing where the concrete was spalled at the joints. The third area of spalling was at a transverse or shrinkage crack 10 feet from the right abutment Two other transverse or shrinkage cracks were noted in the spillway weir. In general, the cracks were parallel with the flow and ran upstream for a distance of about 2 feet until observation was obstructed by the water in the reservoir. The cracks were about 1/4 inch wide and were probed to a depth of about 1/4 inch. No differential movement was noted at the cracks. Three small spalled areas and a small crack were observed on the spillway right abutment wall. The spalled areas were, on the average, about 5 inches wide, 6 inches long, and 3 inches deep. The vertical crack ran from the spillway crest to the top of the abutment wall. The crack was probed to a depth of about 1/4 inch. No differential movement was noted at the crack. There appeared to have been an attempt to patch the crack at one time.

The floor of the approach channel was covered with dead leaves. No obstructions were observed in the approach channel. The dry stone wall shown on the spillway plans at the right abutment upstream of the spillway crest was not found.

The spillway apron was generally in good condition. Grass was growing through the riprap cover over about 50 percent of the spillway apron. A 3-foot by 3-foot brush area was observed 2 feet downstream of the spillway weir. Minor debris had collected on the spillway apron. At the downstream end of the spillway apron, the channel invert drops 6 feet, nearly vertical, onto boulders, smaller rocks, and an earthen channel composed

mostly of a hard clay. Construction methods for the channel were unknown, and the channel appeared to have been degrading for many years.

(2) Outlet Works. The outlet works was in fair condition. The intake facilities are submerged. The condition and nature of the intake facilities were unknown since the reservoir water level was at normal pool and no data is available for the design or construction of the intake facilities. The downstream valve of the 20-inch line on the right side was closed and was inoperable. The downstream valve of the 20-inch line on the left side was partially opened by three men in 30 minutes. The packing leaked. The gear reducers were well rusted. All four valves were covered with sawdust.

The two 20-inch diameter cast-iron outlet pipes discharged into the outlet channel. A third 20-inch diameter cast-iron pipe connected to the drainage gallery located in the core wall of the main embankment and discharged into the outlet channel. This drainage pipe was discharging water with a depth of flow of about 1/2 inch in the pipe. A deposit of orange clay was noted directly beneath the core wall drain outlet. The floor and the right outlet channel wall were in good condition. There was a vertical crack in the right outlet channel wall from the channel floor to and through the 9-inch coping on top of the wall. The crack was 1/2 inch wide, 4.3 feet high, and 10 feet downstream from the valve house. It appeared that there was an attempt to patch the crack at one time. The left outlet channel wall was severely deteriorated and undermined (Photograph H). The concrete was disintegrated for about 2 feet immediately below the valve house. The wall was undermined at the junction of the wall and the floor for the entire length of the wall. The maximum distance of undermining into the wall was 14 inches; the maximum vertical distance of the affected area was 27 inches. The concrete coping and the vertical face of the wall was deteriorated at several places to a depth of 3 inches. The 9-inch coping and the top 2 feet of the end of the left outlet channel wall was disintegrated to a depth of 3 inches. There was evidence that repairs had been attempted in the past.

d. Reservoir Area. The reservoir slopes are covered with hardwoods and evergreens. No evidence was visible of creep, rock slides, or land slides. The Owner indicated that sedimentation is not a problem from the standpoint of reduced reservoir capacity. The watershed is primarily owned and controlled by Pennsylvania Gas and Water Company and is predominantly undeveloped.

e. Downstream Channel. The channel immediately below the spillway is roughly rectangular in shape and is composed of a hard clay and loose rocks and boulders. The slope of the channel is steep. At the time of the inspection, the flow in the channel below the spillway was about 3 cfs. The channel appeared to have been undergoing degradation for many years. A wooded area of hardwoods and evergreens starts immediately below the spillway apron. Some trees extend to the immediate overbanks of the channel. Flow from the spillway joins the flow from the outlet works about 0.25 mile downstream of the dam.

The channel immediately below the outlet works channel is the natural streambed of Falling Springs Creek. The bottom of the channel is covered with small, loose rock, and the channel slope is milder than the channel below the spillway. Flow in the outlet works channel was estimated to be less than 1 cfs. The streambed and banks appeared to be in a relatively stable condition.

f. Access Roads to Dam and Outlet Works. The condition of the 2-mile unpaved access road was poor. Access to the dam was obtained by a two-wheel drive vehicle with high ground clearance. No rain was observed on the date of the inspection, but runoff from the hillside was flowing directly down the access road for a distance of about 2,000 feet. The road surface was very irregular with numerous holes and channels cut into the roadway. Access by rubber-tired vehicle would be very time consuming, if not impossible, during periods of high runoff or during severe winter conditions. There is no access road to the outlet works. Access is obtained by hiking through the wooded area that begins immediately below the toe of the dam or by making way through the heavy brush and small trees on the downstream slope of the main embankment.

3.2 Evaluation.

a. Dam.

(1) The continued growth of trees and brush on the embankment slopes and along the toe of the embankments is undesirable.

(2) The two wet areas of the main embankment were noted in inspection reports in 1921, 1933, 1934, 1941, and 1943. No mention was made of wet areas in the 1957 and 1965 inspection reports. The descriptions in the inspections are insufficient to determine if the areas under discussion are identical to the two wet areas observed during the inspection. The areas have apparently stabilized, but because of the potential seriousness of the problem, they are of general concern.

(3) The settling and resulting irregular elevation of the tops of embankments is of general concern, since the spillway capacity is reduced by the lower available head before overtopping. Flow over the low spots could quickly erode the earth embankments.

(4) The large triangular wet area at the toe of the auxiliary embankment is of general concern. The wet area was reported in the 1933 and 1941 inspections, but it was not mentioned in the later inspections in 1957 and 1965. The wet area has apparently stabilized, but because of the potential seriousness of the problem, the swampy condition should be monitored frequently. The small pool of standing water at the left abutment is not of major concern, although accumulation of water at the abutment is not desirable. Apparently surface runoff from above the left abutment is intercepted by the access road, and the flow collects in depressions on the road and along the shoulders of the road.

b. Appurtenant Structures.

(1) Spillway. The condition of the concrete of the spillway weir and spillway abutments is of slight concern at the present time. Additional spalling and surface cracking of the concrete could become more of a concern in the future. The spalling at the joints of the spillway weir could reduce the ability of the weir to act as a watertight structure.

The conditions of the approach channel and the spillway apron are of little concern, although the debris, brush, and grass present are undesirable. There is general concern for the condition at the downstream end of the spillway apron, where the channel invert drops nearly vertical for a distance of about 6 feet. During larger discharges, considerable scouring could occur that might undermine the riprap apron and threaten the toe of the main embankment and the spillway.

(2) Outlet Works. There is concern for the condition of the downstream valve of the right outlet pipe. All operating equipment should be in good condition so their use in not impaired when needed.

The left outlet channel wall was showing evidence of severe deterioration. Lack of maintenance may increase the deterioration and thereby threaten the stability of the wall. Continued deterioration and undermining of the wall could lead to a failure of the wall, which may threaten the toe of the main embankment.

c. Reservoir Area. No conditions were observed in the reservoir area that might present significant hazard to the dam.

d. Downstream Channel. Concern for scouring in the downstream channel below the spillway apron was expressed in Paragraph 3.2b.(1). No conditions were observed in the downstream channel below the outlet works that might present a significant hazard to the dam.

e. Access Roads to Dam and Outlet Works. During inclement weather conditions, access to the damsite by vehicle would be, at best, very time consuming. Access to the outlet works would be by foot through a wooded area, since there is no road or footpath to the valve house.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The spillway is maintained at spillway crest Elevation 1352.7 with excess reservoir inflow dropping 3 feet over the concrete spillway weir onto the hand-placed riprap apron. The discharge joins the original Falling Springs Creek streambed about 0.25 mile downstream and then flows for about 0.3 mile to a 7-foot high masonry diversion dam. Water is diverted at the dam into an earthen canal that empties into Campbell Ledge Storage Reservoir. Falling Springs Creek continues down the steep, narrow valley and discharges into the Susquehanna River. When the water surface elevation at Campbell Ledge Dam drops below the spillway crest elevation, additional water is released from Falling Springs Reservoir through the left outlet conduit to increase the flow into Campbell Ledge Storage Reservoir. The right outlet conduit at Falling Springs Reservoir has not been used for many years. The two gate valves for each outlet conduit are protected by the valve house at the toe of the main embankment. Each upstream valve is normally open, and the downstream valve in the left outlet conduit is throttled for regulation of flow.

4.2 Maintenance of Dam. The dam is visited daily by a caretaker who records the reservoir elevation. The caretaker, who has been working for the Owner for 33 years, also checks the reservoir elevation and chlorination equipment at Campbell Ledge Storage Dam. Reports on daily water levels and any observed deficiences are mailed to the Owner's Engineering Department weekly. The report information is used by the Engineering Department for regulating flows in the distribution system. A Pennsylvania Gas and Water Company engineer makes a formal inspection of the dam each year, and the records are kept on file and are used for determining priority of repairs. Informal inspections are also made when the engineer is on the site for other reasons.

4.3 Maintenance of Operating Facilities. There is no known regular maintenance program for the operating facilities. Maintenance is apparently performed when deemed necessary.

4.4 Warning Systems in Effect. The Owner furnished the inspection team with a chain of command diagram for Falling Springs Dam and a generalized emergency notification list that is applicable for all the Pennsylvania Gas and Water Company dams. The Owner said that during periods of heavy rainfall, available personnel are dispatched to the dams to observe conditions. All company vehicles are equipped with radios, and the personnel can communicate with each other and with a central control facility. Evaluation of risk is made by the Owner's Engineering Department. The Owner's Engineering Department is also responsible for notification of emergency conditions to the local authorities. Detailed emergency operational procedures have not been formally established for Falling Springs Dam but are as directed by the Owner's Engineering Department.

4.5 Evaluation. Except for not opening the valves on a regular basis, the operational procedure is fair. Infrequent operation of the valves could affect their functioning satisfactorily during emergency conditions. If augmentation of downstream flow is alternated between the left outlet conduit and the right outlet conduit, wear on the gate valves caused by throttling would be minimized. Alternation would also reduce the deterioration and undermining of the left outlet channel wall. The procedures used by the Owner for inspecting the dam are adequate, but some needed repairs have not been made. In general, the warning system is adequate, but it is not in sufficient detail to alert the parties downstream that would be affected by a failure of Falling Springs Dam.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features.

a. Design Data.

(1) No hydrologic and hydraulic analyses for the original Falling Springs Dam design were available for review. The spillway capacity has been estimated before and after the 1929 spillway modification.

(2) In the recommended guidelines for safety inspection of dams, the Department of the Army, Office of the Chief of Engineers (OCE), established the criteria for rating the capacity of spillways. The recommended Spillway Design Flood (SDF) for the size (intermediate) and the hazard (significant) classification of Falling Springs Dam is one-half of the Probable Maximum Flood (PMF) to the PMF. If the dam and spillway are not capable of passing the spillway design flood without overtopping failure, the spillway capacity is rated as inadequate. One-half of the PMF was selected as the SDF. If the spillway is not capable of passing one-half of the PMF without overtopping, the percentage of the 100-year flood that the spillway could pass should be determined.

(3) The 1929 "Report upon the Application of the Scranton-Spring Brook Water Service Company" by the Water Supply Commission of Pennsylvania shows a spillway capacity of 800 cfs with 1.5 feet of freeboard. Calculations were performed for this study to determine the spillway capacity without freeboard. The spillway capacity for the design elevation of the dam without freeboard was found to be 1,830 cfs. However, low spots exist on the tops of the embankments that reduce the existing capacity of the spillway to 1,110 cfs at the point of initial overtopping of the dam. The computations are shown in Appendix C.

(4) The Falling Springs Dam watershed is primarily owned by Pennsylvania Gas and Water Company. Most of the watershed is undeveloped, although portions are developed. Hydrologic analysis for this study was based on existing conditions, and the effects of future development of the watershed were not considered.

b. Experience Data. For this study, a PMF peak previously calculated for hydrologically similar Fall Brook Reservoir watershed was transposed to the Falling Springs Reservoir watershed. The PMF peak inflow was estimated to be 3,720 cfs at Falling Springs Dam. The volume of the PMF inflow hydrograph was adjusted to approximate 26 inches of runoff over the entire watershed. The SDF is one-half the PMF or 1,860 cfs. The volume of the spillway design flood inflow hydrograph was adjusted to approximate 13 inches of runoff over the entire watershed. The 100-year flood was estimated from regionalized data obtained from "Hydrologic Study - Tropical Storm Agnes", North Atlantic Division, Corps of Engineers, December 1975. The 100-year peak inflow was estimated to be 1,230 cfs. Hydrology computations are presented in Appendix C.

c. Visual Observations. On the date of the inspection, no conditions were observed that would indicate that the spillway capacity would be significantly reduced during a flood occurrence.

d. Overtopping Potential. For an occurrence of one-half of the PMF, the peak inflow of 1,860 cfs is greater than the spillway capacity of Falling Springs Dam. A check of the surcharge storage effect of Falling Springs Reservoir shows that the surcharge storage available is insufficient to contain an inflow with a peak of 1,860 cfs without overtopping the dam (Appendix C).

e. Downstream Conditions. A small diversion structure consisting of a 7-foot high masonry dam and headworks for a canal is located about 0.6 mile downstream of Falling Springs Dam (Photograph M). At that point, a portion of the flow from Falling Springs Creek is directed via an earthen canal for a distance of about 0.3 mile into Campbell Ledge Storage Dam. Campbell Ledge Storage Dam supplies

water to Campbell Ledge Intake Dam, which distributes water to Pittston, Old Forge, and Taylor. The locations of the dams are shown on Plate 1.

Below the diversion structure, Falling Springs Creek drops very steeply through a narrow valley until it reaches the Susquehanna River valley. The creek crosses under a secondary highway and the tracks of the Coxton Yards of the Lehigh Valley Railroad immediately before emptying into the Susquehanna River (Photograph N) 1.3 miles below Falling Spring Dam.

A large discharge from Falling Springs Dam would almost entirely be confined to Falling Springs Creek valley. Damages could be incurred by one or two isolated homes, the secondary highway, the Lehigh Valley Railroad and public utilities. The downstream conditions indicate that a significant hazard classification is warranted for Falling Spring Dam.

f. Spillway Adequacy.

(1) The spillway will not pass one-half of the PMF without overtopping the dam under existing conditions. The 100-year flood is 1,230 cfs and is greater than the spillway capacity. A check of the surcharge storage effect of Falling Springs Dam shows that the existing surcharge storage available is sufficient to contain an inflow with a peak flow of 1,230 cfs without overtopping the dam (Appendix C).

(2) Based on established OCE criteria as outlined in Paragraph 5.1a.(2), the existing spillway capacity of Falling Springs Dam is rated as inadequate. Considering the effects of the surcharge storage of 124 acre-feet, the spillway discharge capacity of 1,110 cfs can accommodate a flood with a peak inflow of 1,340 cfs for a storm of the same duration as the PMF. This is 74 percent of one-half of the PMF peak inflow and 112 percent of the 100-year flood peak inflow.

(3) If the low areas of the embankments were to be brought up-to-grade, which could be considered a maintenance task, the spillway capacity of Falling Springs Reservoir would be increased to 1,830 cfs. This would permit the accommodation of a flood with a peak inflow of approximately 2,200 cfs or 118 percent of the Falling Springs Dam one-half PMF peak inflow. The spillway capacity of Falling Springs Dam would then be rated as adequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) General. The visual inspection of the dam resulted in a number of observations relevant to structural stability. These observations are listed herein for various features.

(2) Main Embankment. Two wet areas were observed at the toe of the main embankment near the left abutment. Evidence of settlement of the embankment was also observed. The detailed description and evaluation of the conditions are in Paragraphs 3.1b.(1), 3.2a.(2), and 3.2a.(3).

(3) Auxiliary Embankment. A large swampy area was observed at the toe of the auxiliary embankment and a small pool of standing water was observed near the left abutment. Evidence of settlement of the embankment was also observed. The detailed description and evaluation of the conditions are in Paragraphs 3.1b.(2), 3.2a.(3), and 3.2a.(4).

(4) Spillway. Surface cracks and small spalls were observed on the spillway weir and spillway abutments. The detailed description and evaluation are in Paragraphs 3.1c.(1) and 3.2b.(1).

b Design and Construction Data. No record of design data or stability analysis for the original structures or subsequent modifications was available for review. The structure was studied in 1914 by the Pennsylvania Water Supply Commission. No stability analysis for the structures, as they then existed, was performed.

The existing spillway weir is 3 feet high. During a review of the spillway section (Plate 4), it was judged that the structure would be stable for the expected loads. Stability analyses are not usually performed on structures this small.

c. Operating Records. According to the 1914 Pennsylvania Water Supply Commission Report, a number of local slides in the embankment and settlement of the crest were experienced in the first season the dam was in operation. The slides and settlement were thought to have been caused by improper compaction. The slides were repaired immediately, but the top of dam elevation remains uneven. Other than the sliding and settlement that were experienced during the first season of operation, there is no evidence that the spillway or embankments have experienced stability problems.

d. Post-Construction Changes. Adequate information is available concerning modifications made to Falling Springs Dam after 1914.

e. Seismic Stability. Falling Springs Dam is located in Seismic Zone 1. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading. However, since there are no formal static stability analyses, and since there is the potential of earthquake forces moving or cracking the concrete core wall, the theoretical seismic stability of this dam cannot be assessed.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety.

(1) Based on the visual inspection, available records, calculations, and past operational performance, Falling Springs Dam is judged to be in fair condition. However, deficiencies of varying degree of importance were noted. A summary of the features and observed deficiencies is listed below:

Feature and Location	Observed Deficiencies
Main Embankment:	
Top of Dam	Uneven elevation, trees near junction with spillway.
Downstream surface	Brush and young tree growth.
Downstream toe near left abutment	Two wet areas.
Auxiliary Embankment:	
Top of Dam	Uneven elevation.
Downstream surface	Brush and tree growth.
Downstream toe	Wet area.
Downstream side of left abutment	Wet area.
Spillway:	
Concrete weir and right abutment	Spalling and surface cracking.
Spillway apron	Brush, grass, and debris.

Feature and Location	Observed Deficiencies
Outlet Works:	
Operating equipment	Inoperable valve; lack of regular maintenance.
Left outlet channel wall	Severe deterioration.
Downstream Channel:	
Below spillway	Scour potential during high discharges.
Access Roads:	
Access to damsite	Unpaved road in poor condition.
Access to outlet works	Inaccessible by vehicle.

(2) The overtopping potential analysis shows that Falling Springs Dam will be overtopped by one-half of the PMF under existing condition. Based on OCE criteria as outlined in Paragraph 5.1a.(2), the spillway capacity is rated as inadequate. The existing spillway can accommodate a flood with a peak inflow of 74 percent of one-half of the PMF peak inflow and 112 percent of the 100-year flood peak inflow. If the existing low areas were restored to design grade, the existing spillway could accommodate a flood with a peak inflow of 118 percent of one-half of the PMF peak inflow and the spillway would be rated as adequate.

(3) Because of the low height of the spillway weir, no analysis was performed to calculate the stability. It was judged that the spillway weir should be stable.

b. Adequacy of Information. The information available is such that an assessment of the condition of the dam can be inferred from the combination of visual inspection, past performance, and computations performed prior to and as part of this study.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented as soon as practical or in a timely manner as noted.

d. Necessity for Further Investigations. In order to accomplish some of the remedial measures outlined in Paragraph 7.2, further investigations will be required.

7.2 Recommendations and Remedial Measures.

a. In view of the concern for safety of Falling Springs Dam, the following measures are recommended to be undertaken by the owner as soon as practical:

(1) Develop a detailed emergency operation and warning system for Falling Springs Dam.

(2) Provide closure facilities for the outlet works on the upstream side of the main embankment for periodic inspection of the pipes and for emergency conditions.

b. In order to correct operational, maintenance, and repair deficiencies and to more accurately determine the condition of the dam, the following measures are recommended to be undertaken by the Owner in a timely manner:

(1) Perform additional studies to more accurately ascertain the spillway capacity required for Falling Springs Dam as well as the nature and extent of mitigation measures required to make the spillway hydraulically adequate. Also include provisions to repair the concrete of the spillway weir and right spillway abutment. If the existing low areas of the embankments are restored to design grade, the spillway capacity, according to the method used to analyze the spillway for this study, would be adequate. The filling in of the low areas of the embankments could be considered a maintenance task.

(2) Remove brush and trees that are on or near the embankments. When the brush and trees are removed, the embankments should be inspected on a regular basis to check for wet areas or seepage.

(3) Install six or more observation wells, or other instrumentation, downstream of the axis of the main embankment. One well, or other instrumentation, should be located in the vicinity of each of the two wet areas. The others should be at appropriate locations to determine general water levels in the downstream main embankment.

(4) Install six or more observation wells, or other instrumentation, downstream of the axis of the auxiliary embankment. Two wells, or other instrumentation,

should be located in the general swampy area downstream of the toe. One well, or other instrumentation, should be located near the wet area at the left abutment. The others should be at appropriate locations to determine general water levels in the downstream auxiliary embankment.

(5) Data collected from observation wells or other instrumentation should be utilized in evaluating the stability of the structures and assessing piping potential in the future. Continue to observe wet areas and measure and record seepage downstream of embankments. If conditions worsen, appropriate action should be taken to control apparent seepage with properly designed drains.

(6) Investigate surface runoff from left abutment. If it is determined that the wet area at the left abutment of the auxiliary embankment is caused by surface runoff from the left abutment, provide positive drainage for the runoff.

(7) Repair or replace the downstream valve of the right outlet conduit. Maintain and operate the valves on both outlet conduits on a regular basis.

(8) Repair the concrete of the left outlet channel wall.

(9) Investigate scour damage that could occur during periods of high discharge at downstream end of spillway apron.

(10) Improve damsite access road to ensure access to dam under adverse weather conditions. Provide vehicular access to outlet works.

c. In addition, the following operational measures are recommended to be undertaken by the Owner:

(1) Provide round-the-clock surveillance of Falling Springs Dam during periods of unusually heavy rains.

(2) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

SUSQUEHANNA RIVER BASIN

FALLING SPRINGS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

FALLING SPRINGS DAM

NDS ID No. PA-00372
DER ID No. 35-39

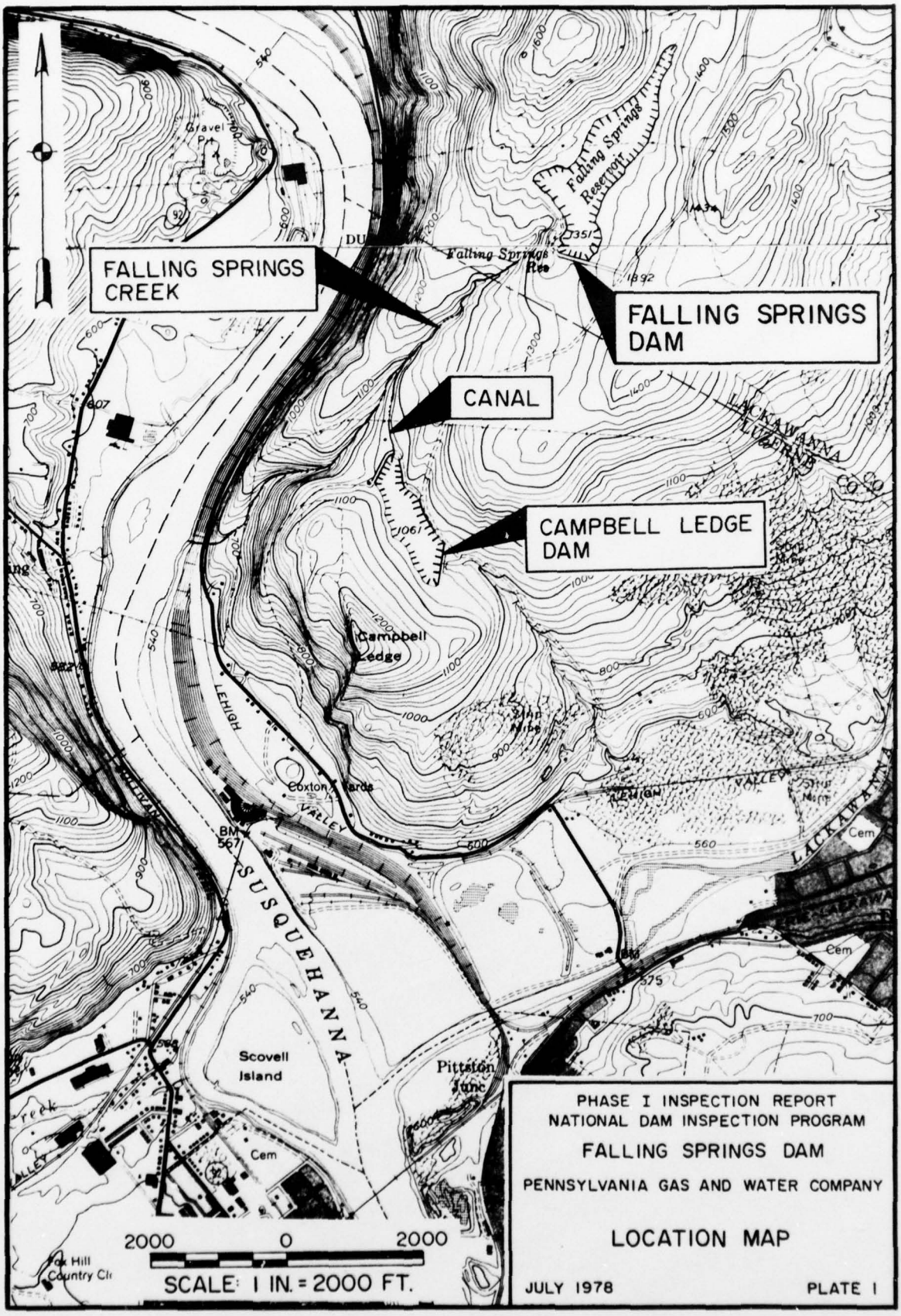
PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1978

PLATES



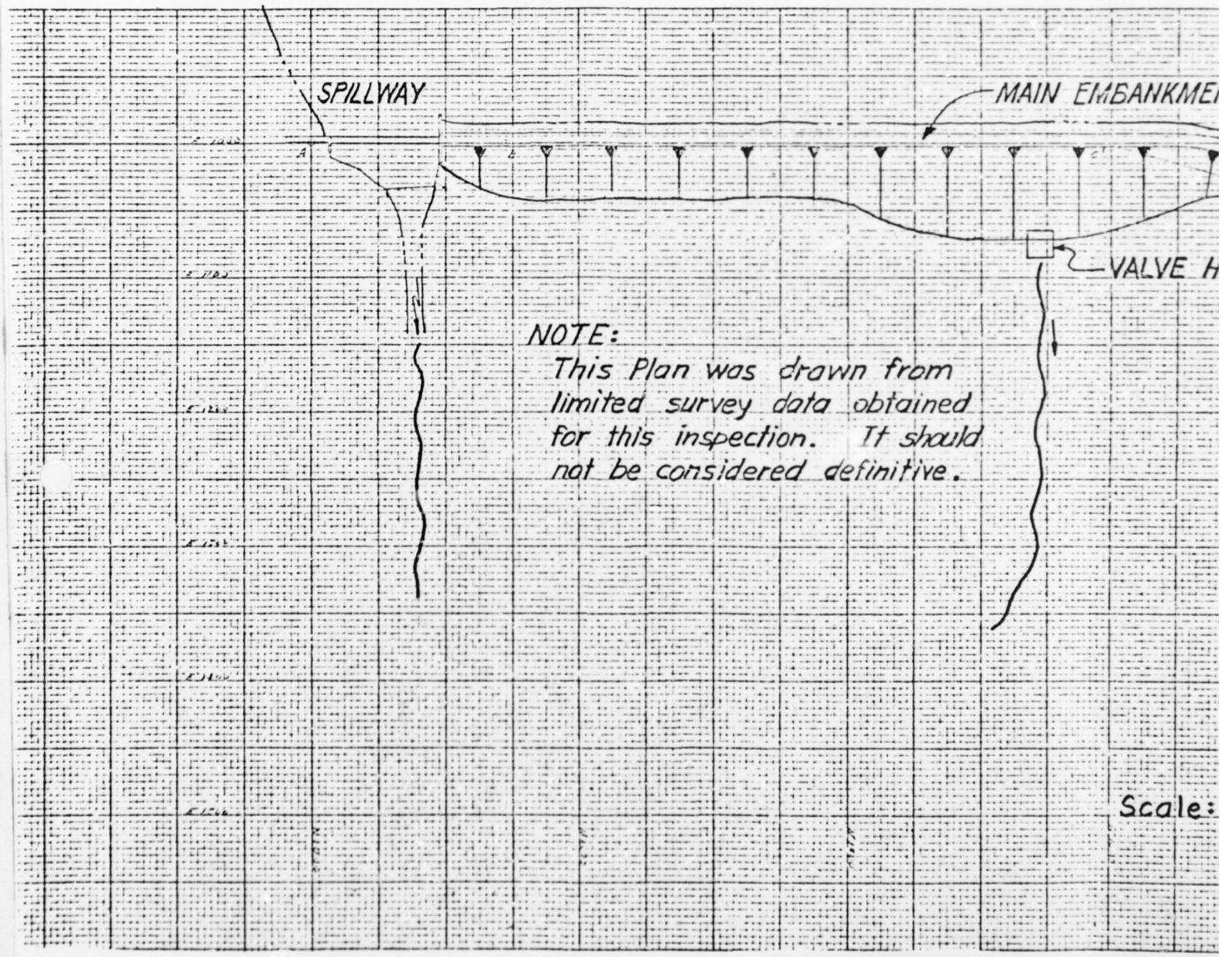
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

FALLING SPRINGS DAM

PENNSYLVANIA GAS AND WATER COMPANY

LOCATION MAP

JULY 1978 PLATE 1



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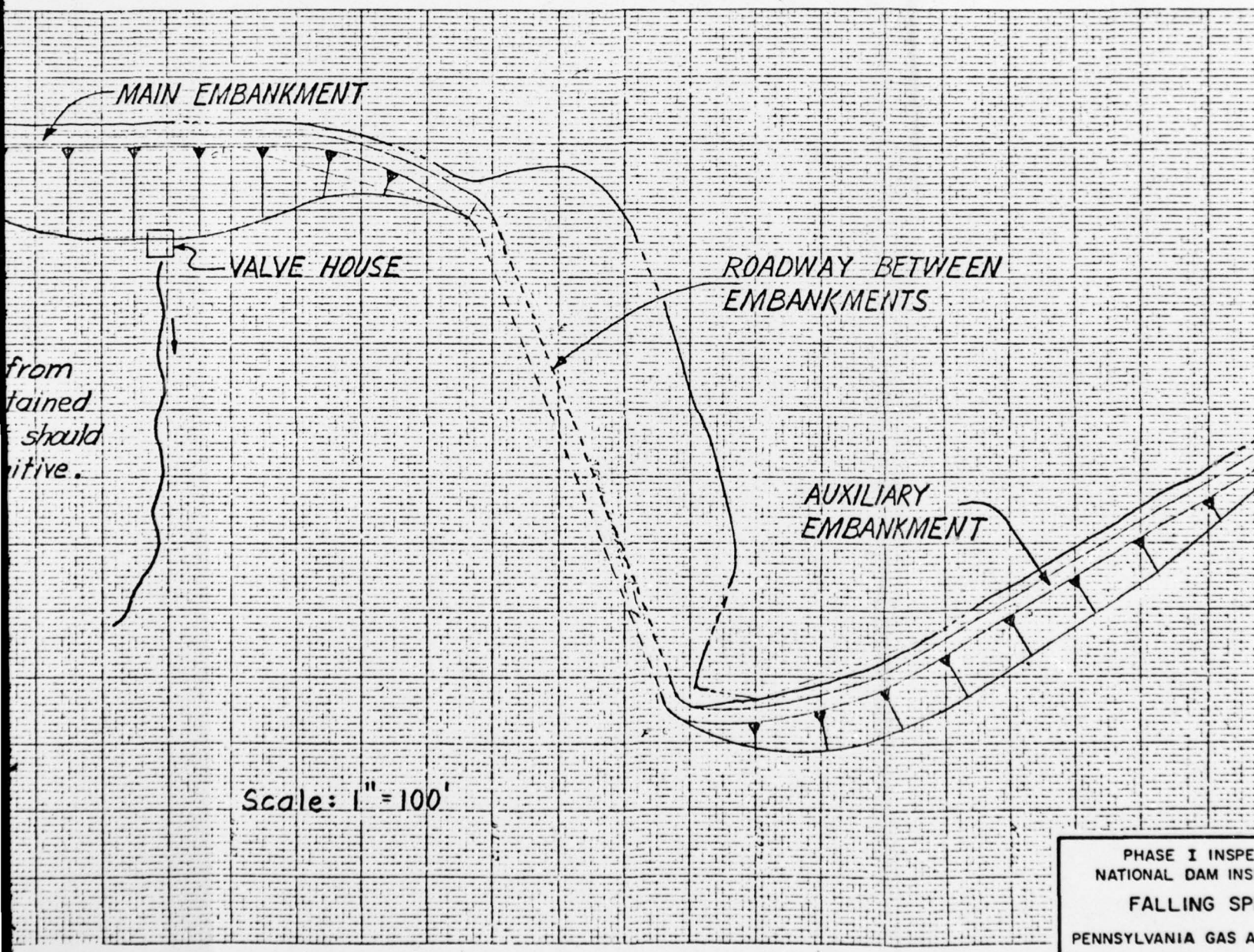

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JULY 1978

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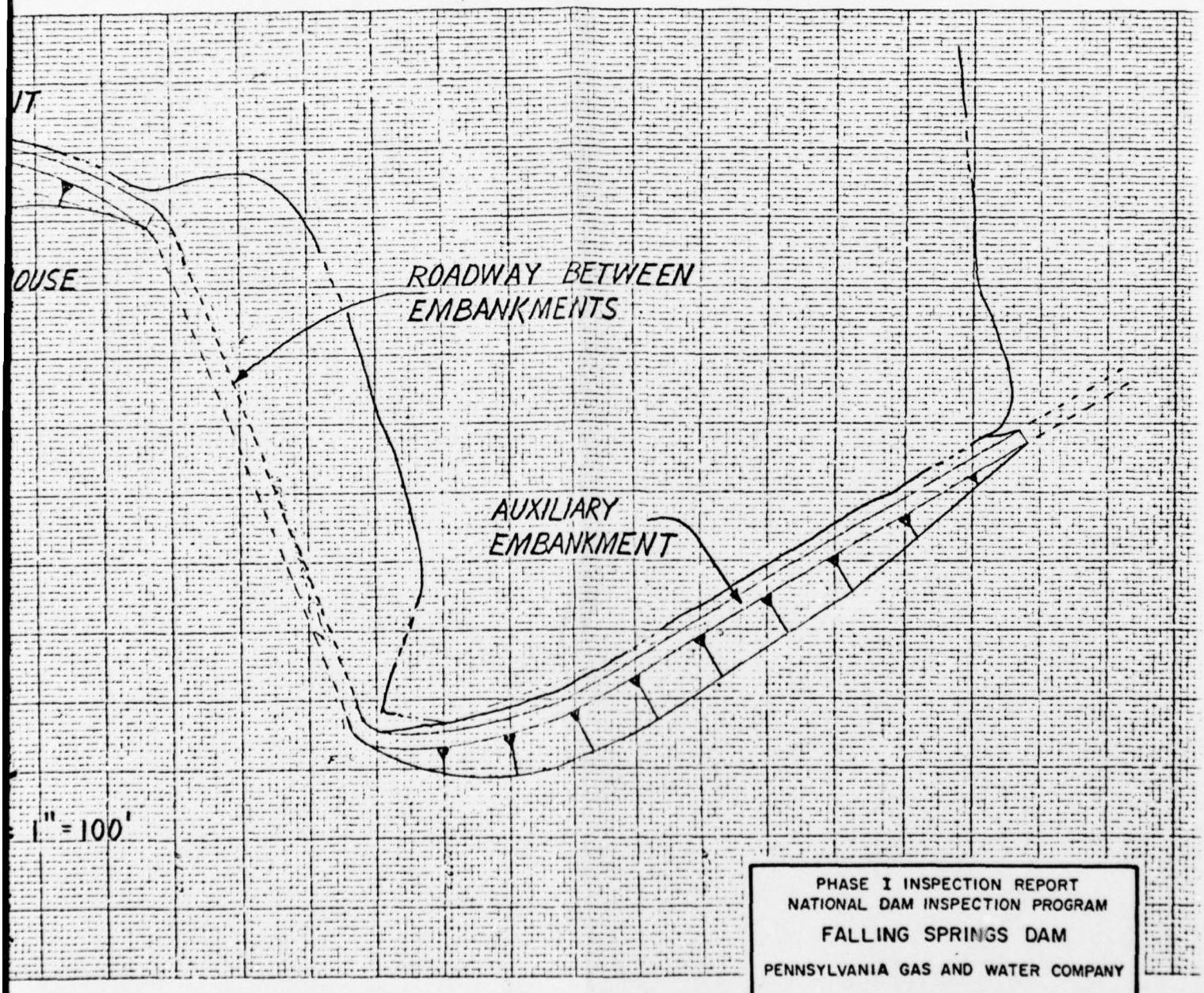


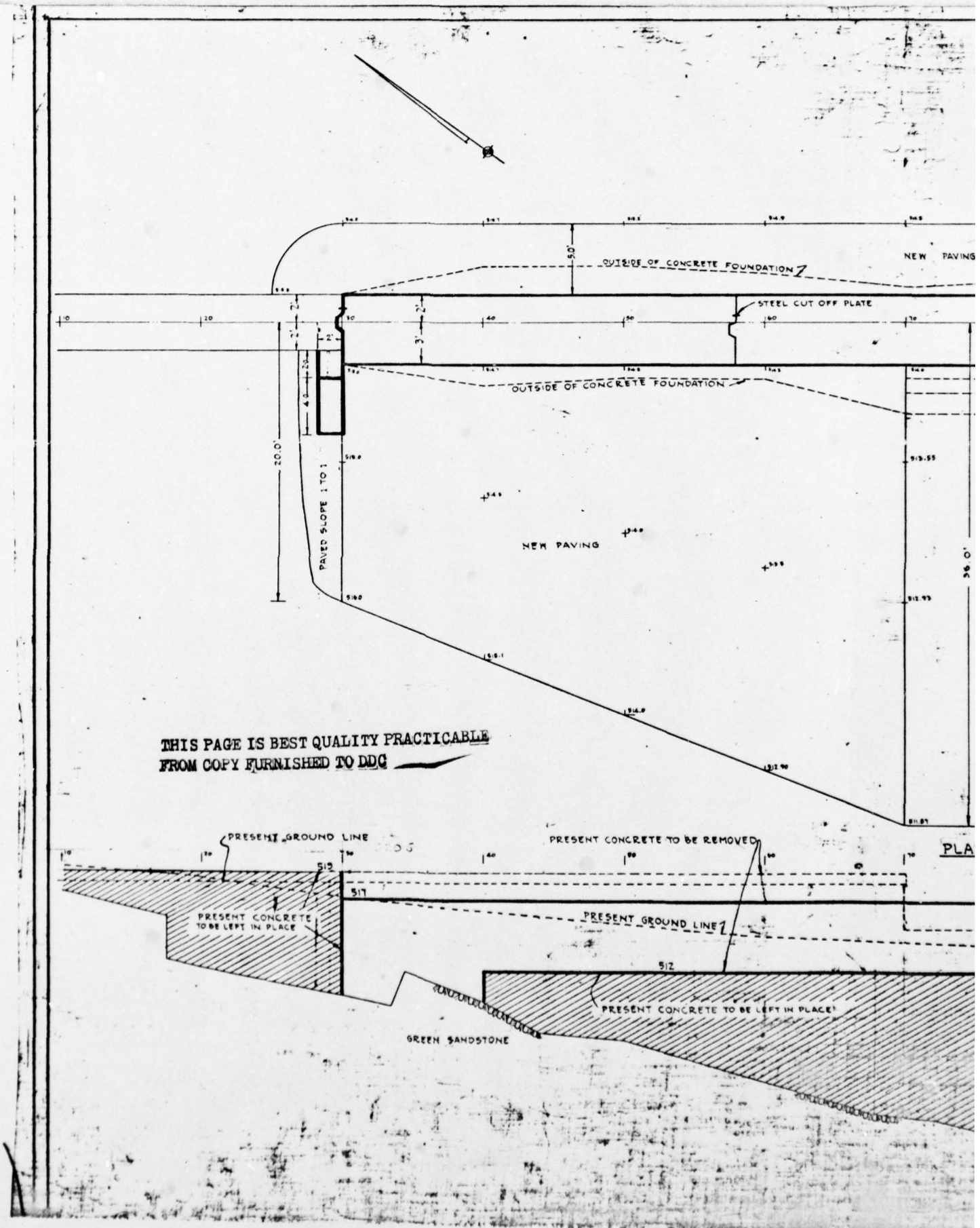
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

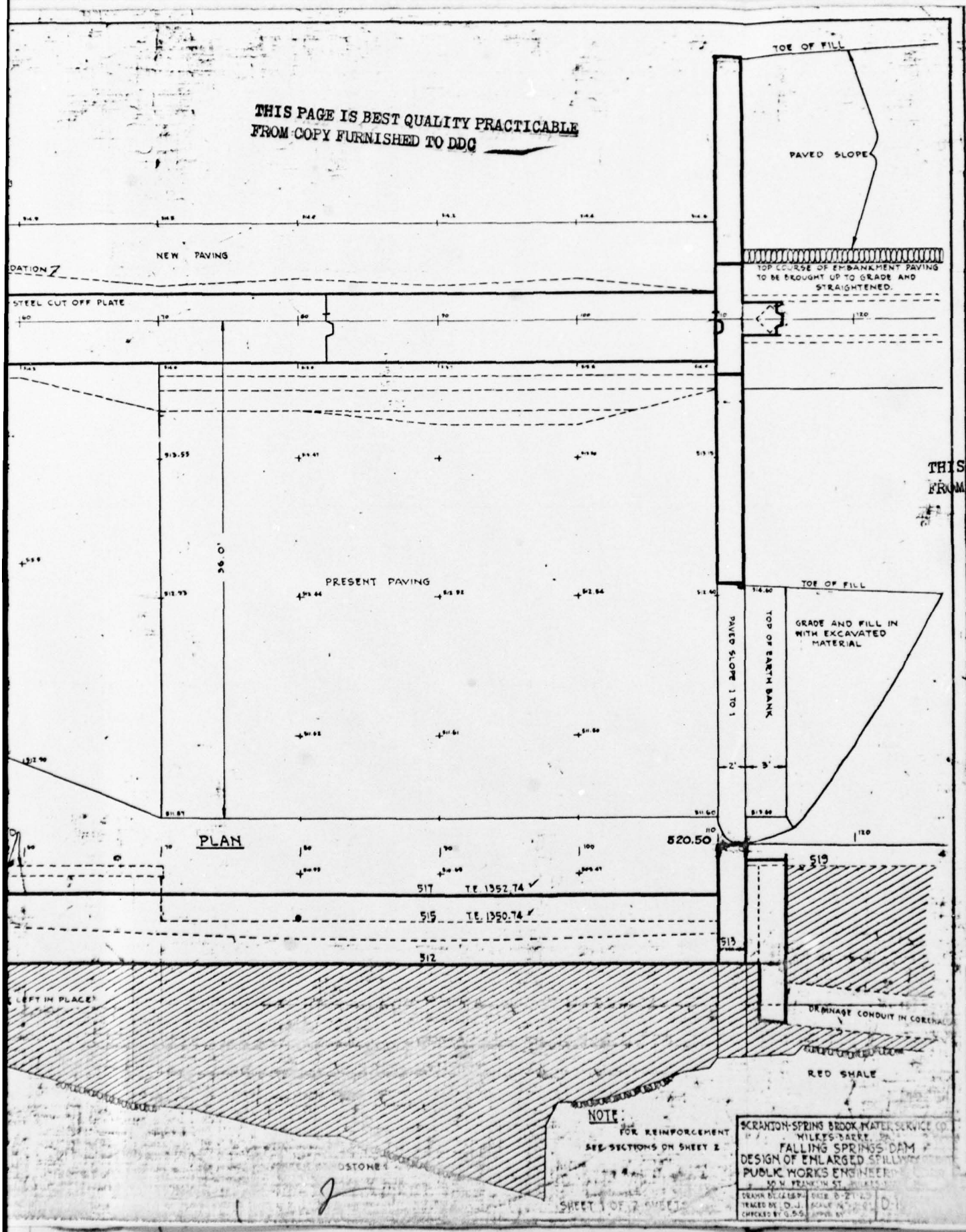
FALLING SPRINGS DAM

PENNSYLVANIA GAS AND WATER COMPANY

PLAN

JULY 1978 PLATE 2





PHASE
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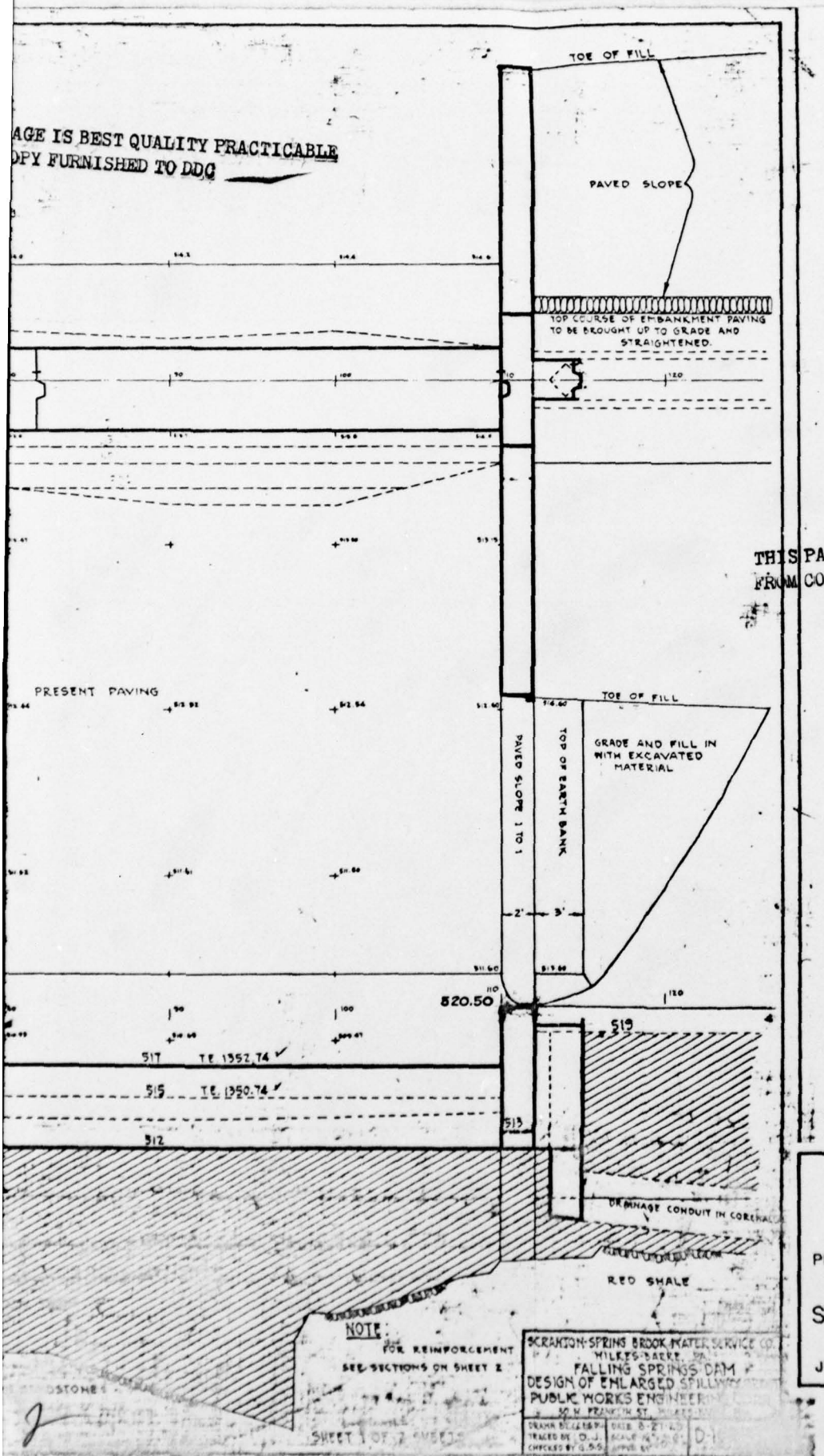
SPILLWAY-
JULY 1978

SCRANTON-SPRING BROOK WATER SERVICE CO.
WILKES-BARRE, PA.
FALLING SPRINGS DAM
DESIGN OF ENLARGED SPILLWAY
PUBLIC WORKS ENGINEER
30 N. FRANKLIN ST.
DRAWN BY C.E.S.P. DATE 8-21-40
TRACED BY D.J. SCALE N
CHECKED BY G.S.S. APPD. BY
D-1

SHEET 1 OF 2 SHEETS



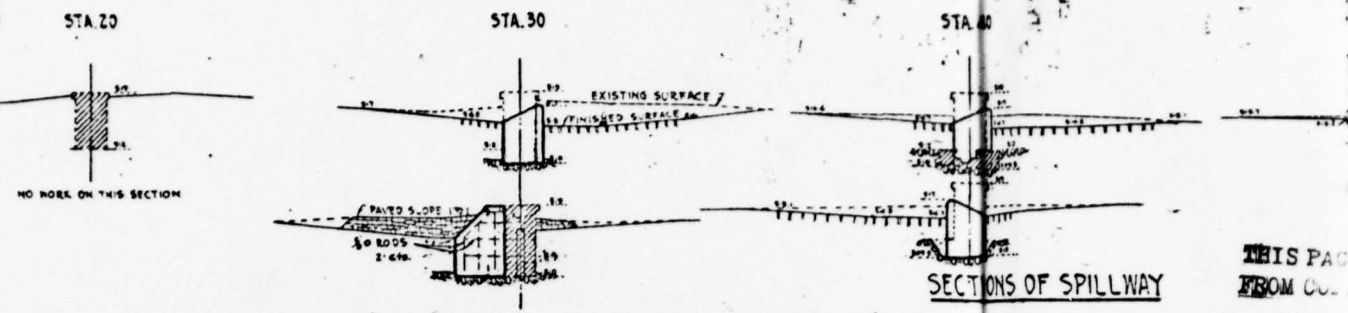
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

FALLING SPRINGS DAM

PENNSYLVANIA GAS AND WATER COMPANY

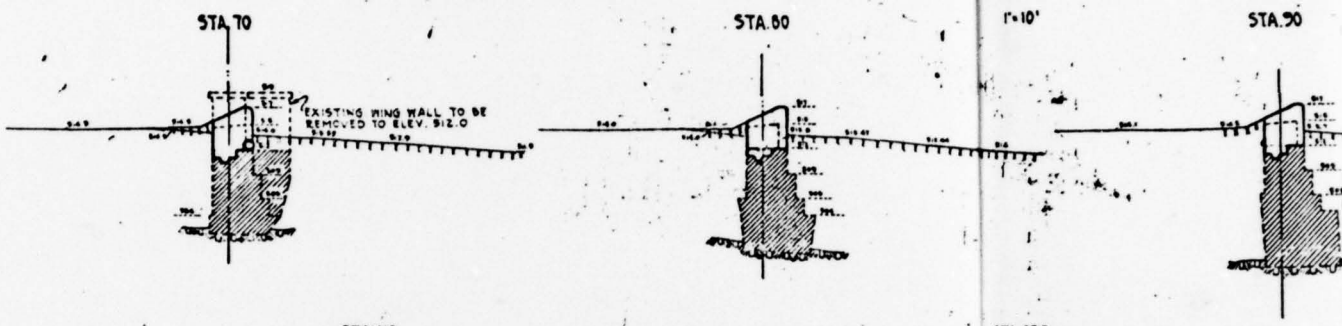
SPILLWAY-PLAN AND PROFILE

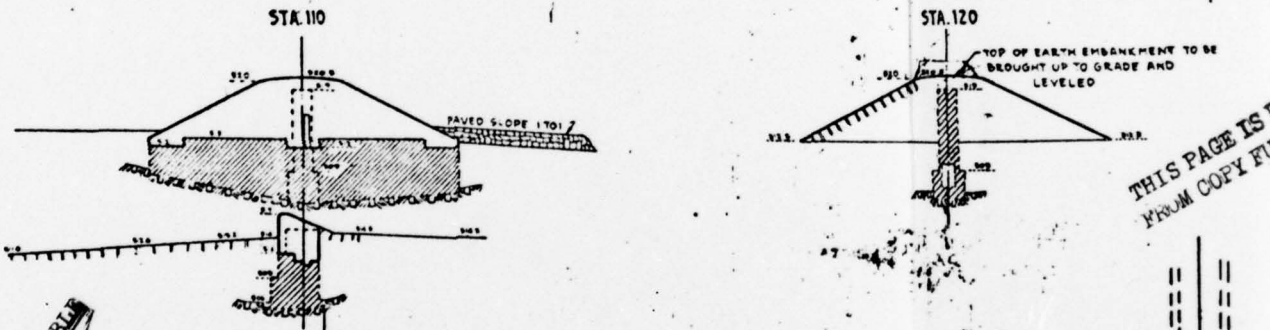
JULY 1978 PLATE 3

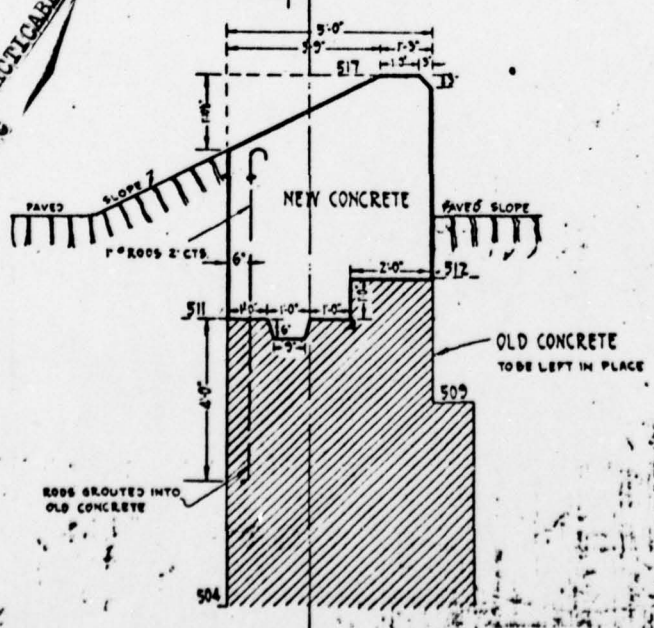


SECTIONS OF SPILLWAY

1"=10'

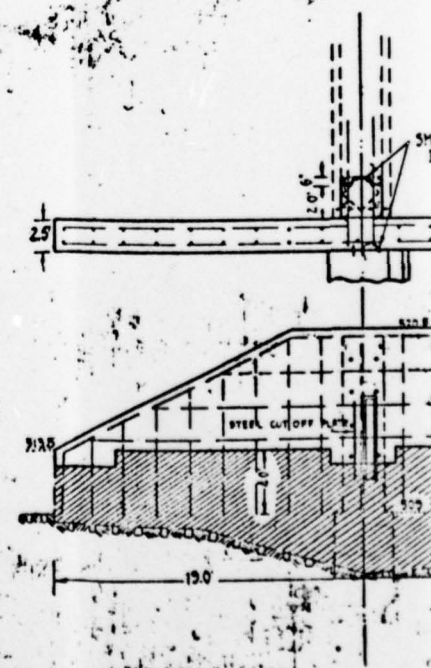




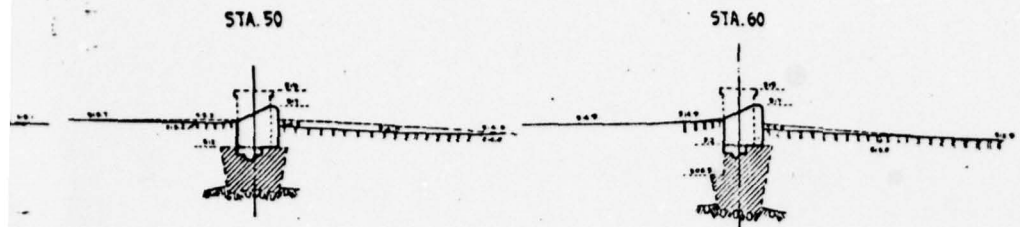


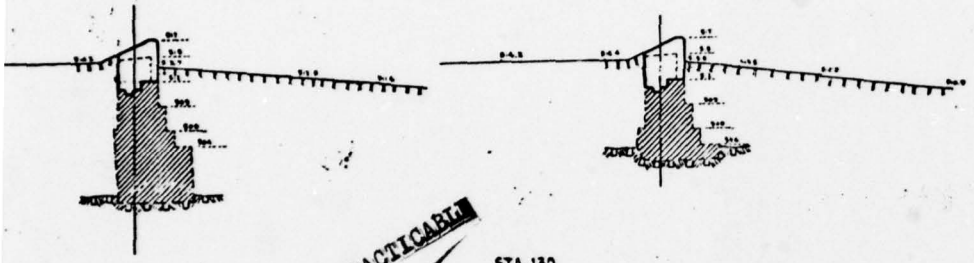
SECTION OF NEW SPILLWAY CREST

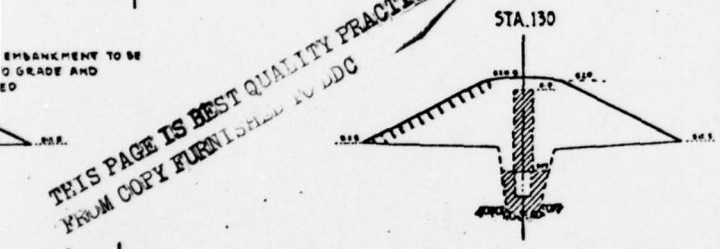
1"=2'



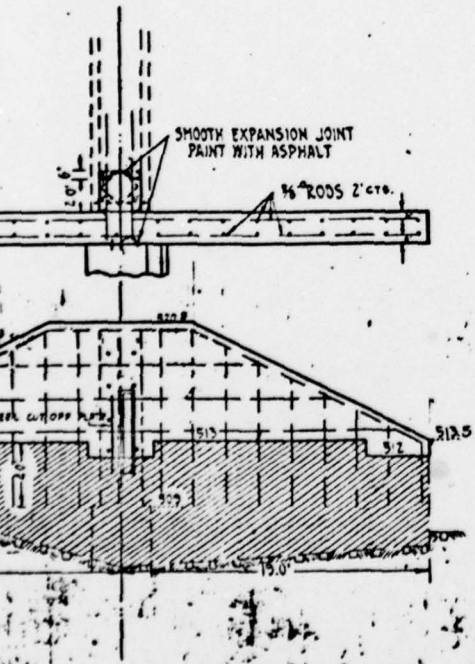
PLAN & ELEVATION OF



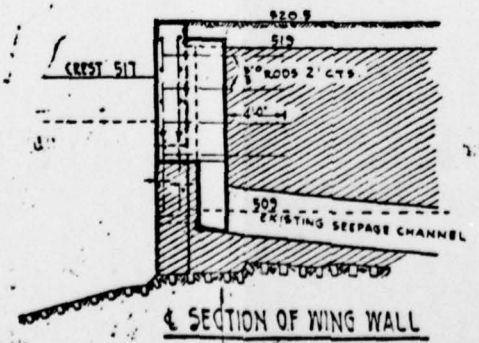




NOTE: HEAVY SOLID LINES INDICATE NEW CONCRETE.
LIGHT DOTTED LINES INDICATE OLD CONCRETE



ELEVATION OF WING WALL



SECTION OF WING WALL

SCRANTON-SPRING BROOK WATER SERVICE CO.
WILKES-BARRE, PA.
FALLING SPRINGS DAM
DESIGN OF ENLARGED SPILLWAY
PUBLIC WORKS ENGINEER.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
FALLING SPRINGS DAM
PENNSYLVANIA GAS AND WATER COMPANY
SPILLWAY - SECTIONS
JULY 1978 PLATE 4

SUSQUEHANNA RIVER BASIN

FALLING SPRINGS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

FALLING SPRINGS DAM

NDS ID No. PA-00372
DER ID No. 35-39

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1978

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: Falling Springs

NDS ID NO.: PA-00372 DER ID NO.: 35-39

ITEM	REMARKS
AS-BUILT DRAWINGS	Construction drawings only for spillway modification in 1929.
REGIONAL VICINITY MAP	Project is shown on Pittston, PA - Quadrangle Sheet N4115-W7545/7.5, 1947 photorevised 1969; and Ransom, PA - Quadrangle Sheet N4122.5-W7545/7.5, 1946 photorevised 1969.
CONSTRUCTION HISTORY	Built in 1905 by Spring Brook Water Supply Company from design and under supervision of John H. Lance. Repairs in 1916. Modified in 1922 and in 1929.
TYPICAL SECTIONS OF DAM	None.
OUTLETS: Plan Details Constraints Discharge Ratings	No plans or discharge ratings available. Details given in 1914 report of Pennsylvania Water Supply Commission.

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	None.
DESIGN REPORTS	Report on application for proposed 1929 spillway modification.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	1914 hydrology and hydraulics check and 1929 hydrology and hydraulics check for proposed spillway modification. No stability or seepage studies.
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	None.
POSTCONSTRUCTION SURVEYS OF DAM	None.

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	Unknown.
MONITORING SYSTEMS	Caretaker visits dam daily to observe and record water level.
MODIFICATIONS	1922 drainage ditch built at left end of main embankment to remedy swampy conditions of the downstream slope at that point. 1929 spillway length increased from 40 to 80 feet. Spillway crest elevation set at former top of flashboards elevation at 1352.74 T.E. Top of embankment raised so that a freeboard of 3-1/2 feet is available on new spillway crest.
HIGH POOL RECORDS	None.
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	First season that dam was in service, slides occurred in clay material on both upstream and downstream faces as described in 1914 Water Supply Commission report.

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	No detailed operation records.
SPILLWAY: Plan Sections Details	Plans and sections of original and modified spillways shown on 1929 spillway modification drawings.
OPERATING EQUIPMENT: Plans Details	Unavailable.
PREVIOUS INSPECTIONS Dates Deficiencies	1917 settlement of top of embankments. 1919 settlement of crest over the entire length. 1920 uneven and unfinished condition of top of embankments-work was in progress of raising top of embankment but was disrupted; saturated area at lower portion of main embankment on the left of the gatehouse; slight disintegration of the concrete in the abutments of the spillway. 1921 work of raising the top of the embankment and relaying the upper part of the paving has not been completed; saturated area at lower portion of the main embankment; deterioration of the concrete at the spillway. 1922 small amount of leakage through wall on right of spillway; raising of top of embankment has been completed on auxiliary embankment but not on main embankment; drainage ditch at left end of main embankment was built; concrete in spillway abutments is disintegrating. 1924 same as 1922.

ITEM	REMARKS
PREVIOUS INSPECTIONS (con't.)	1927 seepage at toe; concrete disintegration on spillway abutments; two openings of 4 feet by 12 inches in flashboards; wall at the right of the spillway and the spillway abutments are badly disintegrated; work on the main embankment is finished but is rough. 1929 concrete wall on the right of the outlet is badly disintegrated; construction material in spillway; work in progress of rebuilding the spillway. 1930 small stream from the toe at the left end of the main embankment. 1933 considerable brush growing on the downstream face of the embankment; stream of a depth of 1-1/2 inches from the 20" C.I. core wall drain; leakage at the blowoff and in back of the valve house; considerable amount of water from blind drain along the left end of the main embankment and adjacent to the steep hillside; considerable amount of brush growing on the auxiliary embankment and there is a swampy area along the toe of the auxiliary embankment near the left end. 1934 double line of small pine trees along toe; about 1-1/2 inches of water flowing from core wall drain; seepage from left hillside; small flow at end of blind drain at left end of toe and from point 10 feet to right. 1941 number of stones from dry masonry wall at upstream edge of crest are displaced; slight flow from core wall drain; some flow from blowoff pipe; seepage between left and center pipe at valve house outlets; downstream slope was wet and swampy at valve house; seepage from ledge rock of left hillside near base of main embankment; small amount of leakage in several places at toe to left of valve house; toe of auxiliary embankment is wet and swampy over a length of about 150 feet; tree growth across lower end of wasteway; disintegration of concrete in pavement at lower end of blowoff pipes; pine trees along toe at intersection of dam and right hillside. 1943 stones displaced from dry masonry wall upstream face; seepage from shale rock ledge on left end near toe

ENGINEERING DATA

ITEM	REMARKS
PREVIOUS INSPECTIONS (cont'd.)	of embankment; slight flow from core wall drain; downstream toe was swampy around valve house at toe; disintegration of concrete pavement and walls below blowoffs; pine trees along toe at intersection of embankment and right hillside.
	1957 wasteway channel riprap is loose; torn-up dead trees in wasteway channel should be cleaned out; general need for maintenance. 1965 few small trees and brush on downstream face.

CHECKLIST

ENGINEERING DATA

HYDROLOGY AND HYDRAULICS

NAME OF DAM: Falling Springs NDS ID NO.: PA-00372 DER ID NO.: 35-39

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): Elevation 1352.74

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Elevation 1356.24

ELEVATION MAXIMUM DESIGN POOL: Elevation 1356.24

ELEVATION TOP DAM: Elevation 1356.24

SPILLWAY CREST:
- a. Elevation 1352.74 T.E.
- b. Type Concrete, broad-crested weir.
- c. Width 1.0'
- d. Length 80.0'
- e. Location Spillover Right side of main embankment.
- f. Number and Type of Gates None.

OUTLET WORKS:
- a. Type Cast-iron pipe.
- b. Location Near left abutment of main embankment.
- c. Entrance Inverts Elevation 1287.0 (estimated).
- d. Exit Inverts Elevation 1286.14.
- e. Emergency Draindown Facilities 2-20" cast-iron pipes.

HYDROMETEOROLOGICAL GAGES:
- a. Type None.
- b. Location None.
- c. Records None.

MAXIMUM NONDAMAGING DISCHARGE: 1,110 cfs.

SUSQUEHANNA RIVER BASIN

FALLING SPRINGS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

FALLING SPRINGS DAM

NDS ID No. PA-00372
DER ID No. 35-39

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1978

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: Falling Springs County: Lackawanna State: Pennsylvania

NDS ID No.: PA-00372 DER ID No.: 35-39

Type of Dam: Earth with concrete core wall-2 embankments. Hazard Category: Significant

Date(s) Inspection: 5-6 June 1978 Weather: Partly cloudy, warm Temperature: 71° F.

General Soil Condition: Moist

Pool Elevation at Time of Inspection: 1352.8 msl/Tailwater at Time of Inspection: 1283.8 msl

Inspection Personnel:

D. R. Ebersole (GFCC)	D. R. Kaufman (PG&W)	
W. E. Seip (GFCC)	J. Skoritowski (PG&W)	
A. H. Whitman (GFCC)	E. Sharjolis (PG&W)	

J. M. Crouse (GFCC) Recorder

MAIN

EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Upstream surface submerged. No cracks on downstream surface.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	None.	
CREST ALIGNMENT: Vertical Horizontal	Vertical: alignment uneven-small pools of water stand in tire tracks of roadway along dam crest. Horizontal: no irregularities.	
RIPRAP FAILURES	Riprap on upstream embankment slope generally in good condition.	General cover of light brush over riprap. Brush is about 18" high in most places; at several locations, brush is somewhat heavier and is about 3-1/2' high.

MAIN
EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	Several trees of about 12'height and 4" diameter at the junction of the main embankment with the left end of the spillway on the crest.	
ANY NOTICEABLE SEEPAGE	Clear seepage at vertical rock face 100' to left of valve house. Area of seepage is 100' x 40'. Second clear seepage area at toe 20' from rock cliff. Joins first seepage 15' D/S.	Seepage forms small stream in open channel. Total discharge 5-10 gpm. Seepage stream joins outlet works discharge about 180' D/S.
STAFF GAGE AND RECORDER	None.	
DRAINS	20" cast-iron pipe drain from longitudinal tunnel in the base of the core wall of the main embankment. Rock-lined open channel drain at lower portion of main embankment on left side of valve house.	Flow from core wall drain about 5" wide-orange, fine, clayey material at outlet invert and in D/S channel. Flow in channel drain 5-10 gpm.
CONDITION OF DOWNSTREAM SLOPE OF EMBANKMENT	Brush over entire area about 3-1/2' high. Brush is more dense in places and is mixed with young trees up to 12' high and 3" diameter. Row of mature pine trees spaced at 12' at toe. Fallen, rotting 50' tree on slope.	Beer cans and cutting debris scattered over slope area.

AUXILIARY
EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Upstream surface submerged. No cracks on downstream surface.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	None.	
CREST ALIGNMENT: Vertical Horizontal	Vertical: alignment uneven-small pools of water stand in tire tracks of roadway along dam crest. Horizontal: no irregularities.	
RIPRAP FAILURES	Small, local displacements of riprap on upstream face. Riprap is generally in good condition.	Riprap is generally covered with small brush 18" high.

AUXILIARY
EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	Small pool of standing water at left abutment on downstream face. Water probably from surface drainage from access road.	Pool area is 6' long by 5' wide. Pool is 1/2 foot deep. No outflow from pool.
ANY NOTICEABLE SEEPAGE	General wet area at toe of dam about 200' long. Swampy condition extends downstream about 600' and is roughly triangular in shape. No discernable flow. No outlet from swamp.	Old cuttings of brush and small trees lying in swampy area of toe.
STAFF GAGE AND RECORDER	None.	
DRAINS	None.	
CONDITION OF DOWNSTREAM SLOPE OF EMBANKMENT	Generally covered with brush with average depth of 3-1/2'. Broadleafed trees 60' in height immediately below toe.	

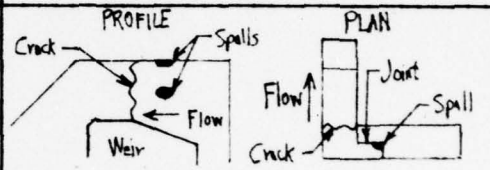
OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Outlet conduits are cast-iron pipe.	
INTAKE STRUCTURE	Condition and design unknown.	
OUTLET STRUCTURE	Valve house contains four gate valves with well-rusted gear reducers. Valves covered with sawdust. Core wall drain pipe runs under valve house.	
OUTLET CHANNEL	Right channel wall: vertical crack 1/4" wide by 4-1/4" high from channel floor to and through top 9" coping. Crack is 10' downstream from valve house. Left channel wall: complete disintegration of wall immediately below valve house-top width affected.	Evidence of attempted repair at one time. CONTINUED ON PAGE B-11
EMERGENCY GATE	Three men opened left conduit downstream valve partially in 30 minutes-packing leaked. Three men tried unsuccessfully for 30 minutes to open right conduit downstream valve.	Left downstream valve should be opened and lubricated. Valve should be used frequently. Footing in valve house should be wooden floor instead of sawdust so more leverage can be applied to valves.

UNGATED SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Concrete is spalled at both monolith joints and at transverse crack 10' from right abutment. Depth affected is average of 9" and vertical height is 10". Joint filler was missing at the monolith joints. Two other transverse surface cracks were observed.	Moss growth on downstream face and crest. Exposed coarse aggregate entire wetted surfaces. CONTINUED ON PAGE B-11
APPROACH CHANNEL	No dry masonry wall on right side of approach channel as shown on plans. From 3' from crest on upstream, approach channel floor is covered with dead leaves.	
DISCHARGE CHANNEL	Lined with hand-placed riprap for a distance of about 60 feet, transitions to width of about 14 feet, drops off a depth of 6', and returns to rock and hard clay channel.	Grass about 8" long over 50 percent of riprap-brush area 3'x3' that is 2' downstream of weir and 8' from left abutment. Minor debris below crest.
BRIDGE AND PIERS	None.	
RIGHT SPILLWAY ABUTMENT	Three small spalled areas about 5"x6"x3" deep on vertical face and top of wall. Vertical surface crack from spillway crest to top of abutment wall. Width of crack 1/4"; depth of crack 1/4". No differential movement. Crack repair was attempted at one time.	

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	

RESERVOIR AND WATERSHED

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Steep to moderate slopes; no evidence of creep, rock slides, or land slides.	
SEDIMENTATION	No sediment problem reported by Owner.	
WATERSHED DESCRIPTION	Predominately controlled and forested; minor development.	

DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	Small amount of debris immediately below spillway crest.	
SLOPES	Moderate slope of riprap-lined channel to near vertical drop at downstream edge to steep channel of rock and hard clay.	Downstream channel and banks show signs of erosion.
APPROXIMATE NUMBER OF HOMES AND POPULATION	Only a few inhabitable structures would be affected by a large discharge from dam.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
OUTLET CHANNEL (cont'd. from B-6)	is 18", increases to 2 feet at base of wall, depth affected is 15" into wall. Channel face and lower portion of 9" concrete coping deteriorated at several places to a depth of 3" and height of 6".	
	Base of wall disintegrated and undermined for entire length-maximum depth into wall of 14" and maximum of 27" in vertical height. End of concrete wall disintegrated 3" in depth and 2 feet in vertical	Apparent repair attempt was made some time in past.
	height.	
CONCRETE WEIR (cont'd. from B-7)	running into the reservoir for about 2'. The cracks were about 1/4" wide and 1/4" deep. No differential movement at any crack or joint.	

SUSQUEHANNA RIVER BASIN

FALLING SPRINGS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

FALLING SPRINGS DAM

NDS ID No. PA-00372
DER ID No. 35-39

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1978

APPENDIX C

HYDROLOGY AND HYDRAULICS

CLASSIFICATION

SIGNIFICANT HAZARD, SINCE RELATIVELY FEW LIVES COULD BE LOST AND APPRECIABLE ECONOMIC LOSS COULD RESULT FROM A FAILURE OF THE DAM

INTERMEDIATE SIZE, SINCE HEIGHT = 61 FEET AND CAPACITY = 898 AC-FT

REFERENCE: "RECOMMENDED GUIDELINES FOR SAFETY INSPECTION OF DAMS," P. D-8

SPILLWAY DESIGN FLOOD (SDF)

THE SDF SHOULD BE ½ PMF TO PMF (FROM P. D-12 OF "REC. GUIDELINES ..."). FROM THE BALTIMORE CONTACT, MIKE KANOWITZ, THE SPF IS ½ PMF.

HYDROLOGY AND HYDRAULICS ANALYSIS

REFERENCE: PHASE I PROCEDURE PACKAGE

II. A. 2. PMF INFLOW HYDROGRAPH NOT AVAILABLE

a. FROM CONVERSATION OF MIKE KANOWITZ WITH ACH, PRORATE PMF AT FALLING SPRINGS D.A. = 1.25 SQ. MI., WITH PMF PEAK OF 9,700 CFS AT FALL BROOK, D.A. = 9.14 SQ. MI.

GENERALIZED FORM OF TRANSPOSITION

$$\frac{Q_1}{Q_2} = \left(\frac{D.A._1}{D.A._2}\right)^{0.8}$$

OR, $Q_1 = Q_2 \left(D.A._1 / D.A._2 \right)^{0.8}$

$Q_1 = 9{,}700 \left(1.25/9.14 \right)^{0.8}$

$Q_1 = 3{,}720$ CFS = PMF

$\therefore$ ½ PMF = 3,720 CFS/2 = 1,860 CFS

EFFECT OF UPSTREAM RESERVOIRS

NO UPSTREAM RESERVOIRS EXIST

B. ABILITY OF SPILLWAY TO PASS ½ PMF

1. CAPACITY OF SPILLWAY - REFERENCE, "REPORT UPON THE APPLICATION OF THE SCRANTON - SPRING BROOK WATER SERVICE COMPANY," 19 SEPTEMBER 1922, WATER SUPPLY COMMISSION OF PENNSYLVANIA.

DISCHARGE CAPACITY = 800 CFS WITH A HEIGHT OF 2 FEET OVER THE CREST. THE CONCRETE WEIR TO BE BUILT WILL HAVE A TOTAL THICKNESS OF 5 FEET, THE CREST ONE FOOT WIDE, A SMALL 1 TO 1 SLOPE AT THE DOWNSTREAM EDGE AND A 2 TO 1 APPROACH SLOPE.

CALCULATE THE DISCHARGE COEFFICIENT USING THE GENERALIZED WEIR EQUATION ($Q = CLH^{3/2}$)

$$C = Q / L H^{3/2}$$
$$C = 800 / (80)(2)^{3/2}$$
$$C = 3.54, \text{ SAY } 3.5, \text{ WHICH IS OK FOR THE SPILLWAY APPROACH AND GEOMETRIC CONDITIONS}$$

FROM THE FIELD SURVEY CONDUCTED DURING THE VISUAL INSPECTION OF THE DAM, TWO LOW AREAS EXIST ON THE AUXILIARY EMBANKMENT AT ELEVATION 1,355.2' AND ONE LOW AREA EXISTS ON THE MAIN EMBANKMENT AT ELEVATION 1,355.3'. SINCE THE SPILLWAY CREST ELEVATION IS 1,352.74', THE MAXIMUM HEAD ON THE SPILLWAY BEFORE OVERTOPPING IS 1,355.2' - 1,352.74' = 2.46', SAY 2.5'. THEREFORE, THE SPILLWAY CAPACITY WITHOUT FREEBOARD IS:

$$Q = C L H^{3/2}$$
$$Q = (3.5)\ 80\ (2.5)^{3/2}$$
$$Q = 1{,}110 \text{ CFS}$$

3. ½ PMF PEAK FLOW IS GREATER THAN THE SPILLWAY CAPACITY (1,860 > 1,110)

b. ROUTING OF ½ PMF IS NOT AVAILABLE

(1.) THE SPILLWAY WILL PASS (1,110 / 1,860) = 0.597 = P = 59.7% OF ½ PMF PEAK

(2.) INCLOSURE 3 METHOD TO ESTIMATE THE STORAGE EFFECT OF THE RESERVOIR

(a) TRIANGULAR SHAPE FOR ½ PMF HYDROGRAPH

(b.) FROM GRAPH OF TOTAL TIME VS. D.A. FOR THE SUSQUEHANNA RIVER BASIN, TOTAL TIME = 20.4 HOURS.

— CHECK INCHES OF RUNOFF PRODUCED BY THE PMF PEAK AND THE TOTAL TIME —

RUNOFF VOLUME = ½ bh = ½ (20.4 HOURS)(1,860 CFS) = 18,972 CFS HOURS

$$18{,}972 \frac{FT^3}{SEC} \times \text{HOURS} \times \frac{3{,}600 \text{ AC-SEC}}{43{,}560 \text{ FT}^2\text{-HR}} \times \frac{12 \text{ IN}}{1 \text{ FT}} = 18{,}815 \text{ AC-IN}$$

DRAINAGE AREA = 1.25 SQ.MI. × (640 ACRES / SQ.MI.) = 800 ACRES

$$\text{RUNOFF AMOUNT} = \frac{18{,}815 \text{ AC-IN}}{800 \text{ AC}} = 23.5 \text{ INCHES}$$

SINCE 25.5 INCHES OF RUNOFF IS A HIGH VALUE FOR ½ PMF, REDUCE THE INCHES OF RUNOFF TO $\frac{26}{2}$ = 13, AS PER THE INSTRUCTIONS OF THE BALTIMORE DISTRICT, MIKE KANOWITZ. FROM ½ PMF PEAK AND THE VOLUME OF RUNOFF PROVIDED BY 13 INCHES OF RUNOFF OVER THE DRAINAGE AREA, CALCULATE THE EQUIVALENT TOTAL TIME OF ½ PMF HYDROGRAPH.

$Vol = \frac{1}{2} bh$; $b = \frac{2 Vol}{h}$

Vol = 13" RUNOFF x 800 ACRES = 10,400 AC-IN

$10{,}400 \text{ AC-IN} \times \frac{1 \text{ FT}}{12 \text{ IN}} \times \frac{43{,}560 \text{ FT}^2\text{-HR}}{3{,}600 \text{ AC-SEC}} = 10{,}487 \text{ CFS-HRS}$

$b = \frac{2 Vol}{h} = \frac{2 \times 10{,}487 \text{ CFS-HOURS}}{1{,}860 \text{ CFS}} = 11.3 \text{ HOURS}$

$1 - p = 1 - 0.597 = 0.403 = \frac{\Delta AOC}{\Delta AOB}$

$\Delta AOB = \frac{1}{2} bh = Vol = 10{,}400 \text{ AC-IN} \times \left(\frac{1 \text{ FT}}{12 \text{ IN}}\right) = 867 \text{ AC-FT}$

SUBSTITUTING, $\Delta AOC = (1-p)\,\Delta AOB = (0.403)(867) = 349 \text{ AC-FT}$

REQUIRED STORAGE = ΔAOC = 349 AC-FT

(c) INCREMENTAL STORAGE AVAILABLE BETWEEN NORMAL POOL ELEVATION AND MAXIMUM POOL ELEVATION

NORMAL POOL ELEVATION = SPILLWAY CREST ELEVATION	=	1352.7'
MAXIMUM POOL ELEVATION = TOP OF DAM ELEVATION	=	1355.2'
AREA OF RESERVOIR WITH W.S. @ SPILLWAY CREST	=	49 ACRES
AREA OF RESERVOIR WITH W.S. @ TOP OF DAM	=	?

ASSUME RESERVOIR SIDE SLOPES OF 4H ON 1V AND ASSUME CIRCULAR SHAPE

$49 \text{ ACRES} \times \frac{43{,}560 \text{ FT}^2}{1 \text{ ACRE}} = \pi r_1^2$

$679{,}913 \text{ FT}^2 = r_1^2$

$r_1 = 824.3 \text{ FT}$

$r_2 = r_1 + \Delta H = r_1 + 4(\Delta V) = r_1 + 4(2.5') = 824.3' + 10 = 834.3'$

$A_2 = \pi r_2^2 = \pi (834.3')^2 = 2{,}186{,}500 \text{ FT}^2$

$A_2 = 50.2 \text{ ACRES}$

INCREMENTAL STORAGE = $\left(\frac{A_1 + A_2}{2}\right) \Delta V = \left(\frac{49 + 50.2}{2}\right) 2.5'$

INCREMENTAL STORAGE = 124 AC-FT

STORAGE REQUIRED = 349 AC-FT > STORAGE AVAILABLE = 124 AC-FT

∴ THE SPILLWAY OF FALLING SPRINGS DAM IS INADEQUATE

PERCENT OF ½ PMF THAT SPILLWAY CAN PASS

GENERAL FORMULA

$$\%\text{ OF } \tfrac{1}{2}\text{ PMF THAT SPILLWAY CAN PASS} = \frac{Q_T}{Q_{\frac{1}{2}PMF}} \times 100\%,$$

WHERE $Q_T = Q_{SPILLWAY} + 2S/\Delta t$,

$S = \sum_{i=1}^{n} S_i$ FOR UPSTREAM RESERVOIR CASES

AND T = EQUIVALENT TOTAL TIME OF PMF HYDROGRAPH

$$\%\text{ OF } \tfrac{1}{2}\text{ PMF} = \frac{1{,}110 + \left(\frac{2 \times (124)\text{ AC-FT}}{11.3\text{ HOURS}} \times \frac{43{,}560\text{ FT}^2\text{-HRS}}{3{,}600\text{ AC-SEC}}\right)}{1{,}860} \times 100\%$$

$$= \frac{1{,}110 + 266}{1{,}860} \times 100\%$$

$$\%\text{ OF } \tfrac{1}{2}\text{ PMF} = 74\%$$

CHECK % OF 100-YR FLOOD THAT SPILLWAY CAN PASS

100-YR FLOOD PEAK ESTIMATE

REFERENCE: "HYDROLOGIC STUDY - TROPICAL STORM AGNES," CofE, NAD, DECEMBER 1975

DRAINAGE AREA = 1.25 SQ. MI. = A

$\text{LOG}(Q_m) = C_m + 0.75\ \text{LOG}(A)$

FROM FIGURE 21, $C_m = 2.08$

$\text{LOG}(Q_m) = 2.08 + 0.75\ \text{LOG}(1.25)$

$= 2.153$

S = STANDARD DEVIATION = $C_s - 0.05\ \text{LOG}(A)$

FROM FIGURE 22, $C_s = 0.358$

$S = 0.358 - 0.05\ \text{LOG}(1.25)$

$= 0.353$

FROM FIGURE 23, SKEW COEFFICIENT = $g = +0.45$

ASSUME EQUIVALENT LENGTH OF RECORD IS 30 YEARS

$\text{LOG}\,Q(P) = \text{LOG}(Q_m) + K(P, g)\,S$

$\text{LOG}\,Q(1) = 2.153 + 2.6505\,(0.353) = 3.089$

$Q(1) = 1{,}226$, SAY 1,230 CFS = 100-YR FLOOD

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT FALLING SPRING DAM (35-39) FILE NO. 7613.1R
HYDROLOGY AND HYDRAULIC ANALYSIS SHEET NO. 5 OF 6 SHEETS
FOR USCE - BALTIMORE DISTRICT
COMPUTED BY JM DATE 6/16/78 CHECKED BY DAW DATE 6-28

% OF 100 YR THAT SPILLWAY CAN PASS = $Q_T / Q_{100} \times 100\%$ (SEE SHEET 4)

ASSUME T = ESTIMATED TOTAL TIME OF PMF HYDROGRAPH. A CONSERVATIVE ESTIMATE WILL RESULT SINCE THE TOTAL TIME OF 100-YR EVENT WOULD BE SOMEWHAT LESS THAN THE TOTAL TIME OF PMF HYDROGRAPH.

$$\% \text{ OF } 100\text{-YR} = \frac{1,110 + \left(\frac{2 \times (124)\ \text{AC-FT}}{11.3\ \text{HOURS}} \times \frac{43,560\ \text{FT}^2\text{-HRS}}{3,600\ \text{AC-SECS}} \right)}{1,230} \times 100\%$$

$$= \frac{1,110 + 266}{1,230}$$

% OF 100-YR = 112 %

SPILLWAY CAPACITY THAT COULD BE REALIZED IF THE EMBANKMENT ELEVATION WAS BROUGHT UP TO THE DESIGN ELEVATION

DESIGN ELEVATION OF EMBANKMENT	=	1,356.2'
SPILLWAY CREST ELEVATION	=	1,352.7'
POTENTIAL AVAILABLE HEAD	=	3.5'

SPILLWAY CAPACITY INCREASE

$Q = C L H^{3/2}$

$Q = (3.5)\ 80\ (3.5)^{3/2}$

$Q = 1,833$, SAY 1,830 CFS

% OF ½ PMF THAT INCREASED SPILLWAY CAPACITY CAN PASS = $\frac{Q_T}{Q_{\frac{1}{2}PMF}} \times 100\%$

$$\% \text{ OF } \tfrac{1}{2} \text{ PMF WITH INCREASE} = \frac{1,830 + \left(\frac{2 \times (3.5 \times 79.6)\ \text{AC-FT}}{11.3\ \text{HOURS}} \times \frac{43,560\ \text{FT}^2\text{-HRS}}{3,600\ \text{AC-SEC}} \right)}{1,860} \times 100\%$$

$$\% \text{ OF } \tfrac{1}{2} \text{ PMF WITH INCREASE} = \frac{1,830 + 372}{1,860}$$

% OF ½ PMF WITH INCREASE = 118 %

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SP 11660A

% OF 100-YR FLOOD THAT INCREASED SPILLWAY CAPACITY CAN PASS = $\frac{Q_T}{Q_{100\text{-YR}}} \times 100\%$

% OF 100-YR FLOOD WITH INCREASE = $\frac{1,830 + 372}{1,230} \times 100\%$

% OF 100-YR FLOOD WITH INCREASE = 179 %

SUMMARY TABLE
% PASSING WITHOUT OVERTOPPING DAM

EVENT	PRESENT CONDITION LOW POINTS IN EMBANKMENT	DESIGN CONDITION EMBANKMENT AT DESIGN ELEVATION
$\frac{1}{2}$ PMF	74	118
100-YEAR FLOOD	112	179

SUSQUEHANNA RIVER BASIN

FALLING SPRINGS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

FALLING SPRINGS DAM

NDS ID No. PA-00372
DER ID No. 35-39

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1978

APPENDIX D

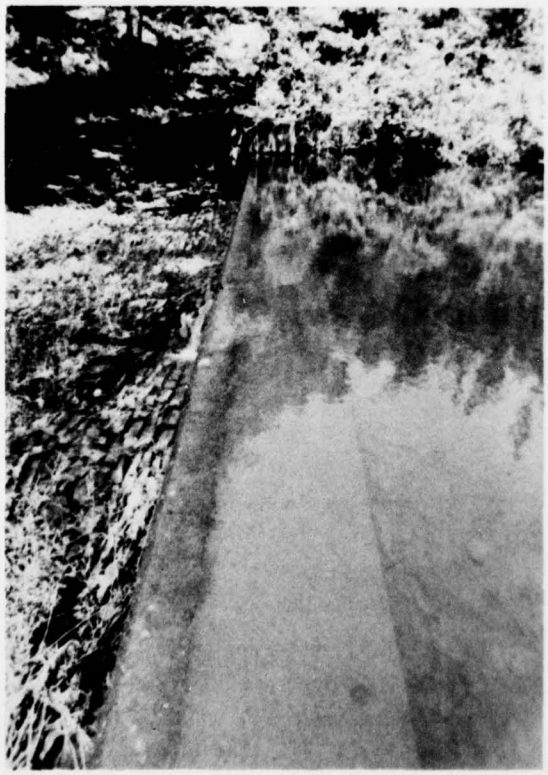
PHOTOGRAPHS

FALLING SPRINGS DAM

A. Main Embankment
View from Right Abutment

B. Main Embankment
View from Left Abutment

C. Spillway



D. Spillway Crest

E. Spillway Apron

F. Downstream Channel from Edge of Spillway Apron
Looking Downstream

G. Core Wall Drain and Outlet Works
from Downstream End of Outlet Channel

H. Undermining and Disintegration of
Left Outlet Channel Wall from
Upstream End of Outlet Channel

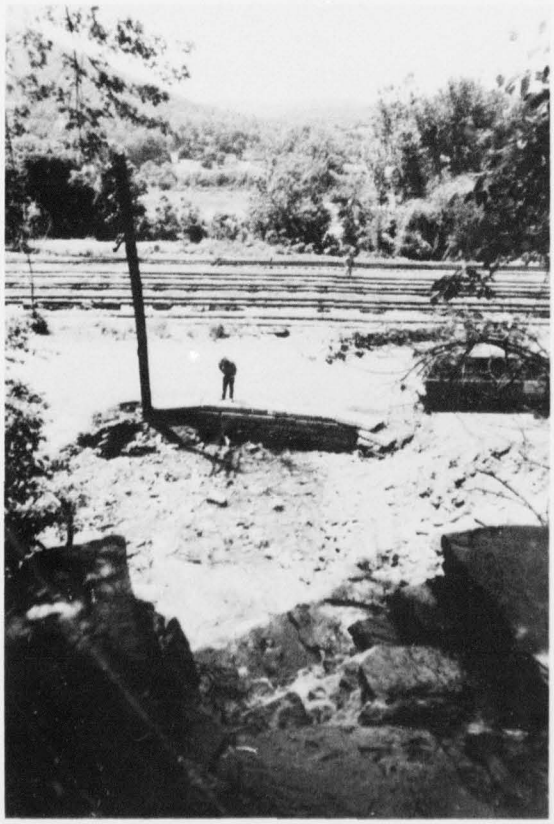
I. Upstream Face of Auxiliary Embankment from High Natural Ground Between the Embankments

J. Auxiliary Embankment View from Left Abutment

K. Riprap on Upstream Face of Embankment

L. Wet Area at Left Abutment of Auxiliary Embankment

M. Diversion Structure Below Falling Springs Dam for Supply to Campbell Ledge Storage Dam



N. Outfall of Falling Springs Creek Under Road and Railroad Tracks into Susquehanna River

SUSQUEHANNA RIVER BASIN

FALLING SPRINGS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

FALLING SPRINGS DAM

NDS ID No. PA-00372
DER ID No. 35-39

PENNSYLVANIA GAS AND WATER COMPANY

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APPENDIX E

GEOLOGY

FALLING SPRINGS DAM

APPENDIX E

GEOLOGY

1. General Geology. The damsite and reservoir are located in Lackawanna County. Lackawanna County was completely covered with ice during the last continental glaciation of Pleistocene time. The general direction of ice movement was S 35° - 40° W. Glacial drift covers the entire County, except where subsequent erosion has removed it. Thick deposits of glacial outwash occur in many places along the Lackawanna River, and are 50 to 100 feet thick near Dickson, Scranton, and Moosic.

The only important structural feature in Lackawanna County is the Lackawanna Syncline, which traverses the County in a southwesterly direction. The syncline enters the County at the northeast corner as a narrow shallow trough, gradually deepens and broadens toward the southwest, and reaches its maximum development in Luzerne County. The rock formations exposed range from the post-Pottsville formations (youngest) through the Pottsville, Mauch Chunk shale, Pocono sandstone to the Damascus formation of the Catskill group (oldest). The rim rocks, the Pottsville formation and Pocono sandstone, have dips that rarely exceed 10° to 20° and form a rather simple syncline. The core rocks, the post-Pottsville formations, are folded into a series of minor anticlines and synclines which trend about N 70° E. The rocks in the northwestern and southeastern parts of the County, outside of the limits of Lackawanna Syncline, are generally horizontally stratified.

The Lackawanna River, in general, follows the axis of the Lackawanna Syncline. Southeast of the Lackawanna River, the rise in terrain in quite gradual and the crests of the high mountains are several miles from the Lackawanna River. Streams, such as Roaring Brook, Stafford Meadow Brook, and Spring Brook, have cut deep canyons through the mountains and follow a tortuous course to their confluence with the Lackawanna River near Scranton, Pennsylvania. Northwest of

Lackawanna River, the mountains rise abruptly to a sharp ridge which in most places is somewhat higher than the country to the northwest. Consequently, most of the drainage in this part of the County flow westward by way of Tunkhannock Creek. A few small tributary streams, however, such as Leggetts Creek, flow eastward from this area into Lackawanna River. In the area of interest, the Lackawanna River streambed is founded in post-Pottsville formations. Proceeding uphill from the river, the older Pottsville formation, Mauch Chunk shale, Pocono sandstone, and Catskill continental group are encountered in turn. The tributary streams, in flowing down the mountains, have generally cut through or around the hard sandstone and conglomerate members, and have eroded their streambed into the softer shales and glacial till. The Catskill continental group of rocks underlies the greater part of Lackawanna County.

2. Site Geology. The dam and reservoir are sited in nearly horizontally stratified gray Catskill sandy shale and Pocono sandstone, northwest of the Lackawanna Syncline and Lackawanna River and northeast of the Susquehanna River into which Falling Springs Creek flows. Whereas, other streams to the north of Falling Springs Creek, cut across the Pocono sandstone formation and drain into Lackawanna River, Falling Springs Creek generally follows the interface between the Catskill and Pocono formations, and parallels the Lackawanna River, to a confluence with the Susquehanna River. Rock at the damsite, whether it be Catskill sandy shale or Pocono sandstone, was hard, firm and close to the surface. The entire dam is founded upon rock.